SCIENTIFIC AMERICAN

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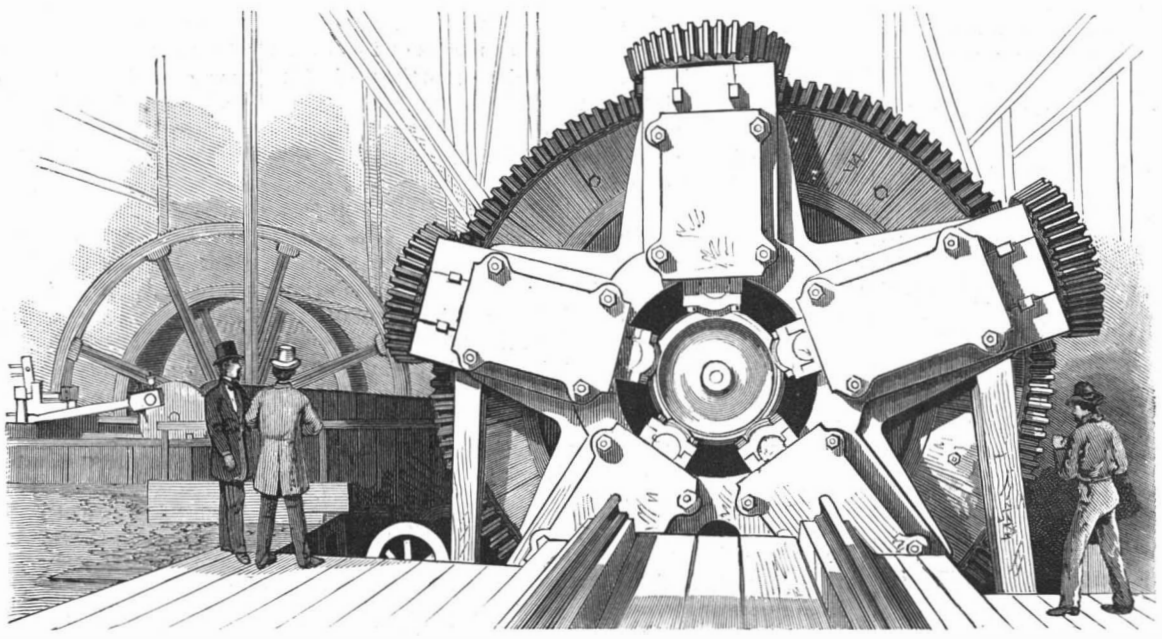
COMPRESSED STEEL CAR WHEELS.

We give a series of engravings illustrating a new method of producing cast steel car wheels, rolled under great pressure, whereby a new product and new and important results are effected. It is the invention of Hervey W. Fowler, of Chicago, Ill., and for the manufacture of the wheels a large plant has been erected at Stony Island, Chicago, by the Fowler Steel Car Wheel Company, and is now in successful operation.

The general process of manufacture is briefly as follows: The wheels are first cast in the finest steel and while still hot are withdrawn from their moulds and subjected to an enormous rolling pressure, in the powerful machine herewith illustrated. Our large illustration shows a view of the car wheel rolling machine, and also a steel wheel blank on the carriage, by means of which it is introduced and removed from the machine.

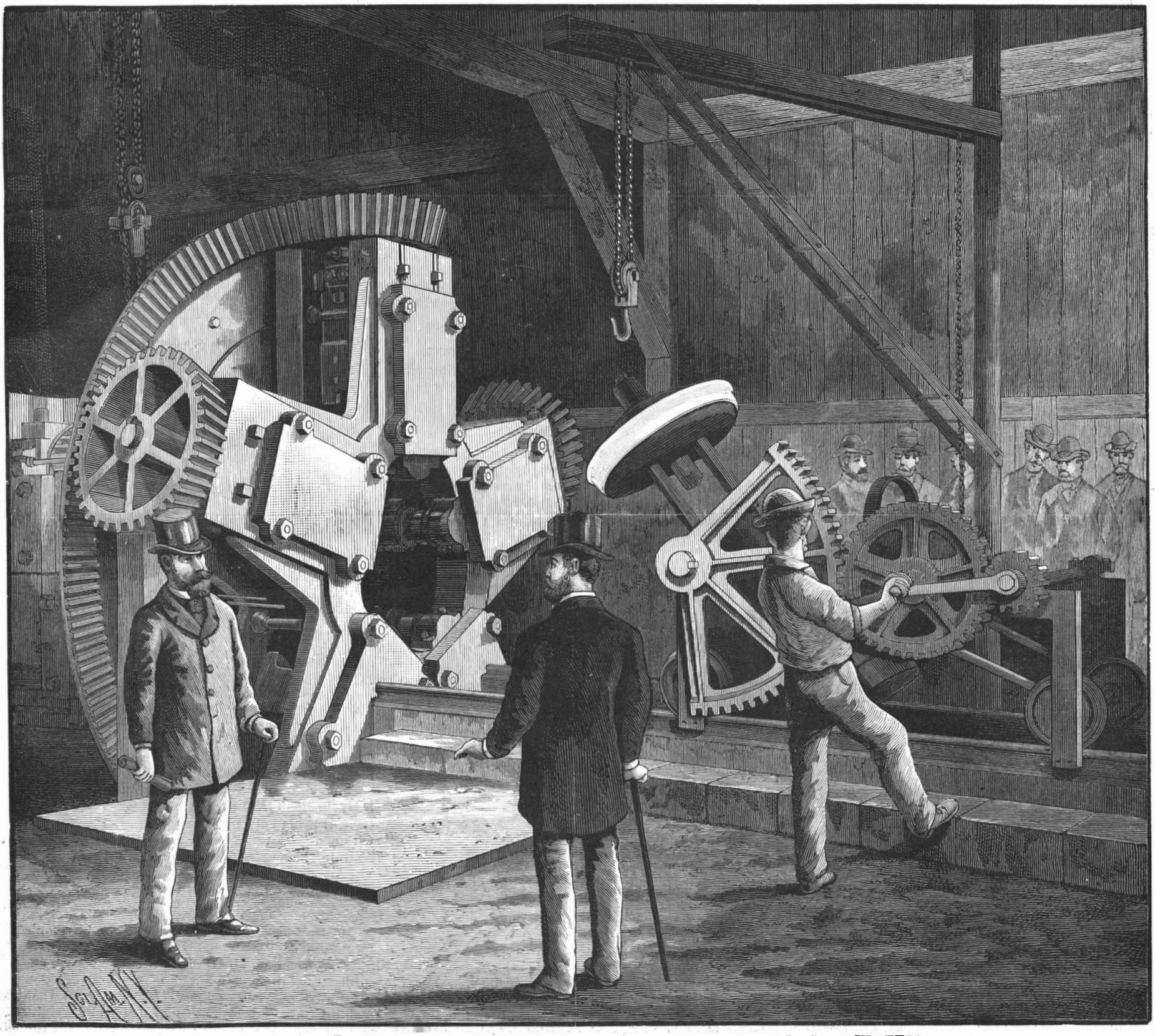


FRONT VIEW OF THE MACHINE, WITH CAR WHEEL BEING ROLLED.

Another illustration is a front elevation of the great machine, showing position of wheel blank while being formed, reduced in diameter and condensed by the embracing rolls.

In order to more clearly show the position of the rolls while operating upon the wheel blank, the car-

(*Continued on page* 178.)



THE FOWLER PROCESS OF ROLLING AND COMPRESSING STEEL CAR WHEELS.

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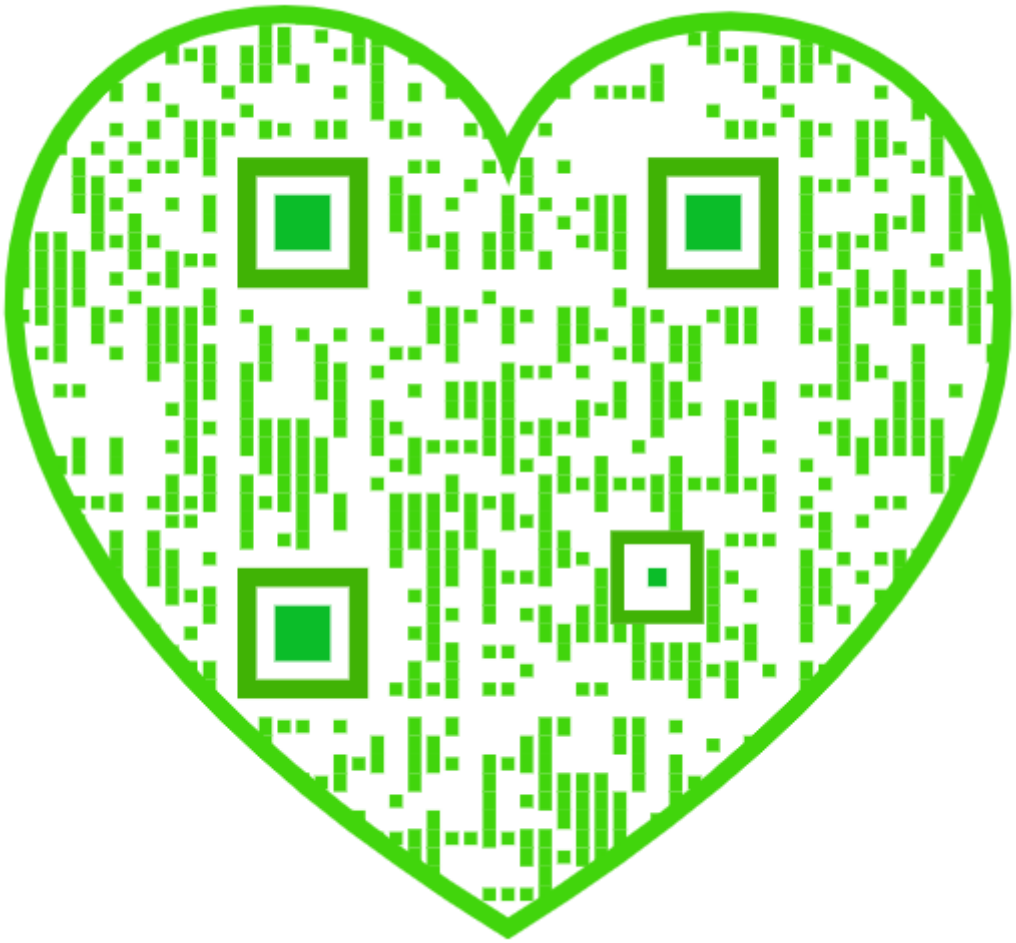

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NEW YORK, SATURDAY, SEPTEMBER 22, 1888.

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WHAT IS THE BEST INSULATION?

What is the best insulation for voltaic arc lighting wires? is an all-important question just now. It might even be called a serious one. There are, it is true, electricians who think, and indeed have publicly avowed, that the wires in their present condition do not threaten life, if only proper care is used in their distribution. Others, whose opinions are quite as worthy of attention, insist that with the present means of insulation and the present strength of currents, these wires are a constant menace. The public, it seems not unfair to assume, is as a unit with these latter, and though it might be said, perhaps with truth, that the public is as unfamiliar with the question as it is easily alarmed, the fact that there is a general lack of confidence in the protection afforded by the present means of insulation ought to be, and indeed is, enough to urge the projectors of this system of lighting to bestir themselves.

At the recent meeting of electric lighting men, the committee long since appointed to inquire into this question of insulation admitted through its chairman, Mr. Elihu Thomson, their inability to make a report. The disappointment thereat was good circumstantial evidence, if such were wanting, to prove how sincere is the desire of the companies to improve their insulation, some members of the association coming from distant parts with the single purpose of listening to this report and profiting by the information which, because of the *personnel* of the committee, there was reasonable hope it would contain.

The reasons for the unusual reticence on the part of this committee are not far to seek; but whether or no they are satisfactory, each interested person must determine for himself, the question being one on both sides of which much may be said. Here are the bare facts gleaned from what was admitted at the convention.

Being practical men, the committee not only examined the relative values of the known kinds of insulation from a laboratory standpoint, but sought information from station superintendents. In both directions the evidence was meager and conflicting. If the name were given of the device which acquitted itself best in the laboratory, it might lead many to adopt a system more certain in small, carefully guarded tests than in general employment, while if the evidence of those who might be interested was accepted, certain manufactures might be praised above their merits and given an undeserved prominence above their rivals.

It might be urged against this that if the committee is afraid to name a manufacture, even if the best of the evidence collected is in its favor, no benefit may be hoped for from its exertions, and all its learning and skill but discover for it a path by which it may depart from its purpose. On the other hand, it seems immediately obvious that it would be hazardous as well as unfair to come to a decision in so difficult a question as this, where reliable evidence is hard to find, and where that which may be had conflicts with experiments made by disinterested hands.

ADDITIONAL POSTAL FACILITIES NEEDED.

We pride ourselves upon being an enterprising nation of liberal and progressive ideas, considerably in advance of our neighbors, especially those of Europe. But in some respects this pride of ours has no basis except self-conceit.

Take for example the matter of postal facilities. We plume ourselves upon the progress we have made. But it required the teachings and example of England and the Continent for nearly half a generation before the Americans opened their eyes and understandings to the success and immense advantages of cheap letter postage.

We have at last got the idea into our heads, and at the present time our people may transmit their letters as cheaply as do the English.

But there is still one branch of the postal service to which we remain blind, although it is of the greatest importance to the public and of enormous value to our postal revenues. We allude to the parcels post, which has long been in successful operation abroad.

The dull Germans have been working the parcels post for several years with great satisfaction. Merchandise of almost any description may be forwarded by mail in Germany, and the public convenience is promoted thereby in a wonderful manner. The rate charged is a little over one cent per pound. Packages of 110 lb. can be sent for $1.20. In 1885 almost seventy millions of packages were transported by mail, the average weight of each being 9 lb., or over six hundred millions of pounds, a quantity greatly in excess of the entire American mails, and fifty times more than the weight carried by our present puny and expensive little package post system.

The postage yielded by the German parcels, for the year mentioned, was $7,776,272.

For many years past, the expenses of the American Postal Department have exceeded the revenues. For the year 1885, the deficiency was $8,318,696. For the present fiscal year, the shortage will be much less. It is evident if a parcels system something like the German were established, the receipts of the department would always be in excess of the expenditures.

One of our great political parties lately adopted as a plank in its platform the idea of a general one cent letter postage. As the chief portion of the revenue of the postal department is derived from letters, the immediate effect of such a reduction would be to knock down the revenues and increase the deficiency. But if we were to add the parcels post, then the receipts would be so much increased that the one cent letter rate could be easily sustained.

Independently, however, of its financial success, the parcels post system would be of extraordinary advantage to the country in promoting internal commerce. It is true we have admirable and effective means for transportation of parcels through the express companies; but they are only a drop in the bucket compared with the requirements of our great country. We have now over 55,000 post offices and 400,000 miles of mail routes; of the latter, less than one-third are traversed by railways.

The great need of the day is the extension of the parcels post system so as to render its benefits available wherever a mail route exists.

It behooves our legislators to cast an occasional glance at the proceedings of other nations and promptly adopt the latest improvements. In regard to mail facilities and war vessels we are greatly behind the age. We originate little in these branches of the public service; we only copy from Europe, and in doing this we are very tardy.

Report of the Commissioner of Patents for the Fiscal Year 1887-'88.

Commissioner of Patents Benton J. Hall in his financial report to the Secretary of the Interior, under date of August 31, 1888, renews the recommendation contained in the report of 1886-'87 relative to the legislation needful in amending sections 4,885, 4,887, 4,898, and 4,930 of the Revised Statutes.

He also calls attention to the urgent need of increased facilities for the conduct of the business by providing additional room. This is a matter becoming more and more serious each succeeding year, as the work increases in consequence of the advancement of every branch of industry. The present space allotted to the bureau in this building is wholly inadequate to secure a prompt dispatch of the business. The importance of providing more room cannot be overestimated, if the business of this bureau is to be conducted as successful commercial men conduct theirs.

The following statements exhibit in detail the business of the office for the fiscal year ending June 30, 1888:

Number of applications for patents.....	34,570
Number of applications for design patents.....	1,068
Number of applications for reissue patents.....	140
Number of applications for registration of trade marks.	1,309
Number of applications for registration of labels.....	682
Number of caveats	2,408
Total	40.277
Number of patents granted, including reissues and designs.....	20,653
Number of trade marks registered.....	1,083
Number of labels registered.....	365
Total	22,101
Number of patents withheld for non-payment of final fees.....	2,957
Number of patents expired.....	11,611

Receipts and Expenditures.

Receipts from all sources.....	$1,122,994 83
Expenditures (including printing and binding and contingent expenses).....	953,730 14
Surplus	$169,264 69

On July 1, 1888, there were 7,227 applications on file still awaiting action on the part of the patent office.

The Eucalyptus for Boilers.

In their official report to Rear-Admiral Gherardi, commandant of the navy yard, a board of naval engineers stated they considered the use of the eucalyptus boiler scale preventive of great advantage in lessening the deposit of scale and in rendering what is deposited soft and easily removable, preventing as it does the scale from adhering to the surface of the boilers. The test had been employed in the steaming boilers of the Richmond for over a year, and the interior surfaces had been kept free from scale without the use of scaling tools, it being only necessary to wash the boilers out with a strong jet of water from the steam hose. In distilling boilers the deposit of scale was also lessened. The interior surfaces of the boilers, these officers reported, show no sign of pitting or corrosion.

THE Hudson River tunnel is about to be completed by British capitalists and by British engineers, viz., Sir J. Fowler and Mr. B. Baker. In a report on the subject the latter state that the work already done is substantial and well designed. They estimate that remaining to be done can be completed in about eighteen months, at an expense of 180,000*l.* for the north tunnel and 250,000*l.* for the south tunnel.

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Richard A. Proctor.

With the deepest regret we have to announce the death of Richard Anthony Proctor, the noted astronomer, who died on the 12th of September in the Willard Parker Hospital, this city. He arrived here on the 10th after a journey by rail from his home and observatory at Oak Lawn, near Orange Lake, Marion County, Fla. Mr. Proctor left his wife, who is suffering from malaria, at Oak Lawn with other members of his family, and was to have sailed on the Umbria on the 15th, for England, where he had engagements to lecture this fall. He traveled alone, and was obliged to pass through the yellow-fever district on his way North. He received a certificate of health from a physician at Orange Lake before he left there.

On the 10th, Mr. Proctor went directly to the Westminster Hotel. On the following morning he remarked to the landlord, Mr. Schenck, that he was not feeling well, and was advised to send for a physician. He retired to his room, and was visited by Dr. George S. Conant, who found him in a semi-delirious condition, and discovered symptoms which led to a suspicion of yellow fever. He called in Dr. Cyrus Edson of the Health Department, and afterward Dr. A. Jacobi. As the result of their examination, it was decided that Mr. Proctor's disease was so much like yellow fever that he ought to be removed immediately from the hotel. He cheerfully consented to go wherever the physicians thought best, and they resolved to send him to the Willard Parker Hospital, whither he was quietly removed in an ambulance that night. When Dr. Edson had made his report to President Bayles of the Health Board, a corps of physicians and fumigators went to the Westminster Hotel and thoroughly disinfected and fumigated the room which had been occupied by the astronomer. Then they ripped up the carpets, tore down the curtains, took the bed apart, and carted everything away. The furniture and other contents of the room were burned.

Richard A. Proctor was born in Chelsea, England, on March 23, 1837. His taste for mathematical studies was evinced at an early age. After studying in an academy at Milton-on-Thames, and serving as a clerk in a London bank, he entered King's College, London, and then St. John's College, Cambridge, where he was graduated in 1860. In the same year he was married. For some time after taking his degree he studied history and literature, and then devoted himself assiduously to astronomy. In 1863 he wrote an essay on "Double Stars," which appeared in the *Cornhill Magazine*. In 1865 he published a monogram on Saturn, and early in 1866 his "Gnomonic Star Atlas" and "Handbook of the Stars." In 1866 he was elected a member of the Royal Astronomical Society, and in 1868 he obtained a seat in its council. In 1874 he was chosen one of its honorary secretaries. "Other Worlds than Ours," his first book of science designed for popular circulation, was published in 1870, and was remarkably successful. It has been followed by many other works from his pen on astronomical subjects, most of them so written as to be attractive to lay readers. His chief scientific work has consisted in the investigation of the evidence available for determining the structure of the stellar and nebular universe. Having analyzed results collected by the Herschels, Struve, and others, and carried out a series of original researches, including the construction of a chart of 324,000 stars, Mr. Proctor was led to a new theory of the structure of the stellar universe. He put forth in 1869, on theoretical grounds, the since established theory of the solar corona, and also that of the inner complex solar atmosphere, afterward discovered by Prof. Young. Since 1878 he had published several volumes of essays on scientific and general subjects, with two treatises on "Whist." For some months before his death he had been at work in the preparation of a popular "Astronomy" on an extensive scale.

In addition to his other work he was a special contributor to the SCIENTIFIC AMERICAN. He prepared for us specially, at one time, a series of twelve original star maps for this latitude, showing the positions of the stars for each month in the year. Added to all his other labors, Prof. Proctor was the editor of *Knowledge*, a popular monthly scientific magazine, published in London.

Mr. Proctor made lecture tours in this country in 1873 and 1875. In 1879 he lectured extensively in Australia. His first wife having died, he married a lady of St. Joseph, Mo., in 1884, and for some time he made that city his home.

Mr. Proctor was perhaps the most prolific writer of his day on scientific subjects, and, as might be expected where an author produces works on such topics with amazing rapidity, his works were not marked by exhaustive research or by so complete and exact accounts of the subjects discussed as would stand the closest scrutiny by experts. In comparison with the mass of popular scientific publications, however, his writings are remarkable for their general accuracy and thoroughness. He wrote with great clearness, with an enthusiasm which communicated itself to his readers, and with a fullness of detail and illustration which are very welcome to the student not already a scientist. All his reasoning was that of a highly disciplined mind, possessing a complete understanding of the mathematical relations involved in the problems considered. As a lecturer he was less successful from a scientific point of view than he was as a writer, being too incautious in his statements, unnecessarily diffuse, and inclined to be rash in his speculations. With the general public, however, his lectures were fortunate efforts, his hearers being always pleasantly entertained, while their minds were enriched with many new ideas.

For most of the foregoing particulars we are indebted to the *Evening Post* of this city.

Joseph Francis.

The venerable Joseph Francis, who for years has pleaded with Congress for recognition of his claim as the inventor of the life-boat, which recognition other governments had already given, has been informed that Congress, a few days ago, passed a resolution which says that "in view of the lifelong services to humanity and to his country of the now venerable Joseph Francis, in the construction of life-saving appliances, by which many thousands of lives have been saved, the director of the mint is hereby authorized and required to strike a gold medal, with a suitable device and inscription, prepared under the direction of the Joint Committee on the Library, to be presented by the President of the United States to Mr. Francis in recognition of his eminent services."

The "venerable Joseph Francis" is now eighty-six years old, and for many years lived at the Stevens House on lower Broadway, but went to San Diego, Cal., last winter. He has spent the whole of his life, since he was eleven years old, in the study and perfection of life-saving appliances. Those who see him for the first time are reminded of some of the genial old characters in Dickens' works. He has a broad and high forehead, with his moderately long gray hair brushed smoothly back from the temples, a neatly trimmed gray mustache and a wee bit of goatee. Add to the pleasing expression of his face his pale blue eyes, which twinkle beneath his shaggy eyebrows, and his old fashioned black frock coat, black trousers, and high standing collar, and one has the quaint appearance of a member of the old school.

"Joe" Francis used to spend his time after school hours reading stories of the terrible shipwrecks, and he was finally encouraged to devise some means of saving life. It was shown that when only eleven years old he made a small boat of his own model, and made compartments in the bow and stern which he filled with old pieces of cork. He then filled the boat with water, and was surprised to find that it would not sink, even after four men got into it. It was the first life-boat ever built in this country. He kept on making improvements until 1819, when a life-boat which he sent to the Massachusetts Mechanical Institute received "favorable mention." This was his first bit of encouragement.

Six years later he brought to New York the first buoyant wooden boat, which he called a life-boat, and exhibited it in the presence of the leading shipping merchants at the foot of Wall Street. He tossed it overboard, bottom up and endwise, and she righted at once. Then he dropped her from the end of a yard-arm of a ship and she went out of sight, but almost instantly rose to the surface, right side up. He filled her with men who tried to capsize and to sink her, but to no use. The boat was exhibited in other cities, and his first order was for two boats from Canada. From that time his fortune began. The Emperors of Russia and Brazil gave him orders for two state barges, and he had orders for pleasure boats and yachts. He continued to improve upon the life-boat, and in 1845 he had perfected an iron life-boat, but the United States government refused to order any of them until he had given it a practical trial.

Finally, on January 12, 1850, the British ship Ayrshire, with 200 people on board, went ashore on the Jersey coast, and he threw a line to her and ran his new life-car back and forth several times, and saved all but one. This made him the hero of the day, and when he went abroad to recuperate his health, the crowned heads came forward to do him honor. Emperor Napoleon, before whom he gave a special exhibition of the life-car, knighted him and gave him a gold snuff box. The box bore the imperial monogram and crown, and was studded with eighty-six diamonds. The Emperor of Russia created him a knight of St. Stanislaus. He received medals of honor and diplomas from all of the crowned heads, and when he returned home he found that his life-car and pontoon wagons for naval and military purposes had been adopted by this government.—*N. Y. Tribune.*

Etching Liquid for Steel.

Mix one ounce of sulphate of copper, one-fourth of one ounce of alum, and one-half teaspoonful of salt reduced to powder, with one gill of vinegar and twenty drops of nitric acid. This liquid may be used either for eating deeply into the metal or for imparting a beautiful frosted appearance to the surface, according to the time it is allowed to act.

Compulsory Insurance in Germany.

From the description given of it in the *Contemporary Review*, one can hardly wonder if the system of compulsory national insurance in Germany finds admirers. Let us put the case as briefly as possible:

A workman earning 20*s.* a week has to pay out of that sum—or, rather, it is deducted for him by his employer—a fraction under 5*d.* as an insurance against sickness and death and 2⅝*d.* as an insurance against old age and infirmity. There is also a special fund against accidents; but to this he contributes nothing. In return he is entitled, as a matter of right, to the following benefits:

1. In case of illness, thirteen weeks' free medical advice and treatment, including dentistry and accouchement fees should he be married; free medicine and minor surgical appliances; a money allowance amounting to one-half of his average wages; or, in place of all this, free board and treatment in a hospital, with, in certain exceptional cases, a modicum of sick money.

2. In case of death, an amount equal to twenty times the local daily wages of an ordinary day laborer is paid to the survivors.

3. In case of accident, the insured workman receives the sick benefit, with the addition of compensation for partial or total disablement or (to the survivors) on death. This, for a workman earning 20*s.* a week, amounts to a pension of 57*s.* 10*d.* per month if he is totally disabled; while, if he is killed, 80*s.* is allowed for burial expenses, and his widow, say with two children, receives 43*s.* 4*d.* per month till the children are fifteen years old.

4. When old age or infirmity comes on, and the workman is no longer fit for labor, he can claim a pension of £6 a year, annually increasing to £12 10*s.*, according to the length of time he has been employed.

Thus the German workman, by the compulsory deduction from his income of less than eightpence in the pound, is secured against everything which can prevent him from following any employment he can get. Sickness, death, disablement, and infirmity are all provided for. The sick insurance system is understood to be self-supporting on the whole. If there should be any deficiency, provision is made for its being supplied by the employers or by the commune. The accident fund, as we have seen, is maintained wholly by the employers. The old age fund is supported by the workmen, the employers, and the State in equal proportions—that is, each pays a third. It will be seen that the only financial liability undertaken by the State is for one-third of the amount of the pensions payable to the aged and infirm; and these, unless some provision be made for them, the State is bound to support in any case. But, of course, the whole scheme is State created, and undoubtedly there is State socialism in it. The deductions from wages are compulsory; so are the payments and the responsibilities which the employers have to bear in the first place and the general community afterward. Some show of non-interference by the State is made by the provision under which the various existing clubs, guilds, and unions are incorporated into the machinery of the system, and are left under the management of the members; but still it is all under the supervision of the Imperial Insurance Bureau. The individual workman has no more control over the amount which goes to his insurance than he has in this country over the payment and disposal of the tax imposed on his beer and tobacco.

"No act has to be done by the workman in order to place himself under insurance; he has literally nothing to do, neither to give notice of membership nor to pay personally any subscription. He enters the insurance by taking work; it is only when he desires not to enter that he must make a declaration and give proof that membership in another club exempts him from compulsion. The employer is responsible for the working of the act with regard to his employes; he has to pay the whole subscriptions, and is also responsible, under penalty, for the due notifications of entrance and exit of members of a club when required."—*London St. James Gazette.*

Trials of Rapid Firing Guns.

A report has just been made to the British War Office upon the experiments recently carried out with the Maxim gun at 600 and 800 yards, in comparison with fire from Martini-Henry rifles. At 600 yards fifteen men, all first or second class shots, fired ten volleys and made 52 per cent of hits in 3 min. 36 sec., while the Maxim, firing the same number of rounds at the same targets, made 81·56 per cent of hits in 2 min. 36 sec. At 800 yards the results were: 15 Martini-Henrys, 40·66 per cent of hits in 3 min. 40 sec.; Maxim, 80 per cent in 1 min. 30 sec. The targets were arranged so that the volleys fired by the men were directed alternately a quarter right and a quarter left, the intervals between the targets being 12 yards; the Maxim fired 15 shots alternately on each target. Further experiments are to be made at unknown distances, and as nearly as possible under service conditions, at ranges between 1,000 and 1,200 yards; and on this occasion the new service rifle, with dial sight, is to be tested.

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COMPRESSED STEEL CAR WHEELS.

(*Continued from first page.*)

riage and front supporting disk were removed before this picture was taken.

The great machine stands 18 feet in height from the bed plate, weighs 112 tons, and is capable of exerting a rolling pressure upon the wheel of 2,500 tons.

The heated wheel is taken from the furnace and placed upon a disk immediately in front of the opening in the machine intended to receive the wheel. Another mould or disk descends upon the wheel, and the two are fastened securely together by an axle passing through the hub of the wheel and drawn tightly together by means of a large key driven through with a sledge. As these disks exactly fit the wheel, and are thus held tightly upon it, there is no chance for the wheel to change shape while the tread is being rolled. The wheel is then tilted upon its carrier and quickly put in place between the rolls. A great engine revolves the wheel rapidly, and five rolls driven by screws operated by a pair of smaller engines press with great power upon the tread and flange of the wheel. It requires 180 revolutions of the engines operating the screws to make one revolution of the screws. The whole process of rolling requires only about two minutes. The rolled surface of the wheel, as it comes out, is polished, and shows clearly the great density of the metal effected by the compression. The diameter of the wheel is reduced about five-eighths of an inch in the process. The wheels are then annealed in the same manner as chilled wheels, after which they are ready for use.

Figs. 2, 3, 4 illustrate the gearing and mechanical combinations of the machine.

Fig. 5 shows a section of a truck wheel divided by a vertical line. The larger part represents a segment of a blank, the other, one-half of the finished wheel rolled therefrom. The relation clearly shows the reduction in diameter resulting from the action of the rolls.

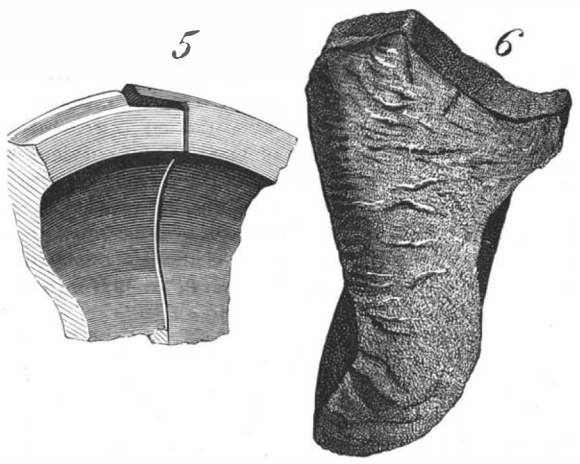
Fig. 6 is a view of a section of the broken rim from a finished wheel, showing the condensation of the steel in the flange and tread caused by the great pressure of the rolls.

The Fowler steel car wheel is an integral cast steel car wheel, having its hub, plate, and the main portion of its rim composed of the metal in its normal condition, with the flange and tread hardened and condensed in radial and peripheral lines, by process of rolling under enormous pressure. It is made from a solid blank of steel. The metal is produced especially for this purpose and is exceptionally strong. As compared with other wheels, it is relatively light (a 33-inch wheel of usual section of rim weighs but 460 lb.) It is rolled under enormous pressure to a perfect finish. It is absolutely round and exact in size. It is durable. The density of the metal in the tread and flange, resulting from the compression during the reduction in diameter, insures a greater mileage than is possible to either steel-tired or chilled wheels. It embodies the requisites of great strength, durability, lightness and concentricity.

The inventor says: The main objects of my invention are to economically correct such peripheral variations as are liable to exist in a solid steel-wheel casting, and also to condense and toughen the tread of the wheel. My machines can, however, be employed, if desired, for rolling the rims of other kinds of car wheels.

So far as I know, steel car wheel castings, if practically rolled at all, have heretofore been so rolled as to increase the diameter of the casting, and such machines as have heretofore been devised would inevitably produce a finished car wheel of greater diameter than the original casting. My machines do not thus increase the diameter of the original casting, but reduce it correspondingly to the degree of condensation and displacement of the metal at the flange and tread of the wheel. By said prior method the web of the wheel has also been rolled simultaneously with the tread; but by my method the wheel at and adjacent to its rim is only operated upon, although the web might be more or less condensed by additional co-operating mechanism without materially affecting my invention. My machines are adapted to properly operate upon a car wheel, whether it be wholly cold, or the rim heated and the web cold, or the entire wheel heated; but of course the results would be more or less varied in harmony with said several conditions. The method or process involved is believed to be novel, as well as the cast steel car wheel produced thereby.

My machine is believed to be novel, in that it embodies the combination of a series of circularly-arranged and positively-driven rolls, each having a pair of flanges or collars and a rolling face, corresponding to the periphery of a finished car wheel, and a housing for said rolls which affords a central space for the free reception of a car wheel, so that its periphery may be properly engaged by the several rolls. The two collars or flanges on each roll constitute means whereby the rim of a car wheel is accurately trued up and the metal confined against undue expansion between the inner and outer faces of the rim. For admitting and discharging a car wheel, and for gradually increasing the rolling pressure thereon, the rolls are radially adjustable, and are locked by adjusting or temper screws, as is common in rolling mills, and said screws are arranged to be simultaneously operated. I also employ driving gearing in a separate housing, and connect with the rolls by means of coupling bars. I have also provided an axial clamp, by which, whenever desirable, the web of a wheel may be supported



during the rolling operation, and I have also provided means whereby said wheel may, when desired, be axially mounted during the rolling operation.

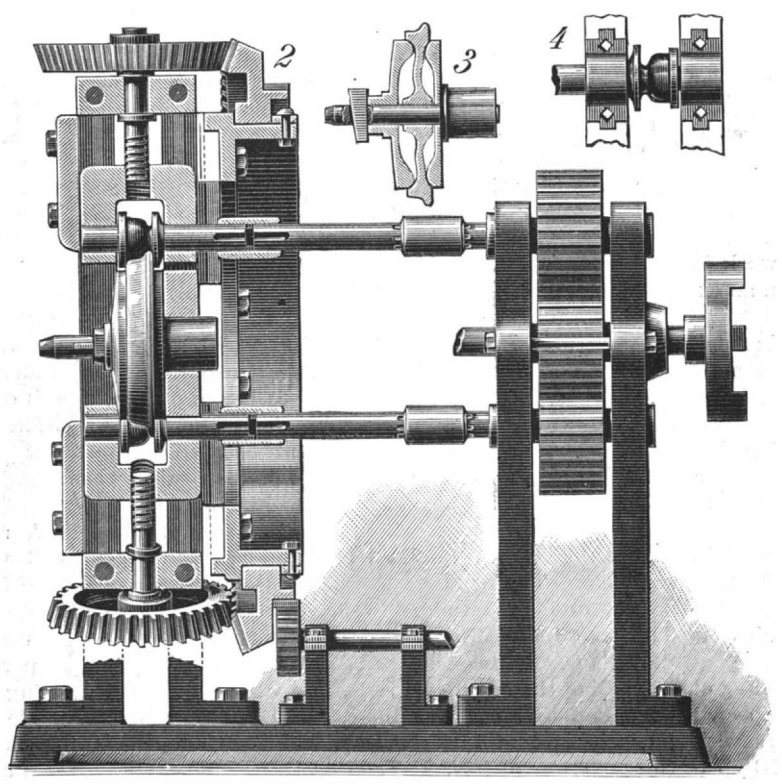
As a rule, I prefer the rolls so arranged that an axial support for the car wheel may be dispensed with, and I have referred to said rolls as being oppositely located, and by this I mean that said rolls are so located with reference to each other that each exerts an opposing rolling force against that of some one or more rolls which are located substantially opposite thereto, and while in most cases it may be desirable to have said rolls exactly equidistant, it is sometimes desirable to have them variably spaced.

Instead of relying upon the original heat in the car wheel casting, I can usually obtain better results by taking a cold casting and heating it in an annularly chambered furnace, which will thoroughly heat the rim of the wheel and keep the center sufficiently cool. When a casting has been thus specially heated, the clamp may or may not be used, according to the dimensions of the wheel and the degree of heat at its hub and web. In some cases a cold casting may be entirely heated and rolled, if due care be given to centrally clamping it, as described.

In rolling the tread of a wheel, the reduction in diameter may be readily gauged by means of suitable calipers, and when an axial support for the car wheel is employed, the careful control of the several rolls will enable the diameter to be accurately gauged.

A cast steel car wheel with its rim or tread rolled and condensed, as in my machine, and by the method described, is a novelty in the trade, and has special value because of the fact that the tread is thoroughly condensed, and is practically circular, and is considerably less in diameter than the original casting. Such wheels can be produced at much less cost than the well known steel tire wheels, or others of a composite structure, and yet mine are capable of similarly extended service with equally desirable results, and in many cases unequally worn wheels can be rerolled in my machines and rendered suitable for further and efficient service.

Referring to Fig. 6, it will be readily seen that the flange is perfectly developed, and it will be obvious that it, as well as the tread, must be composed of metal so condensed and worked as to render it well suited for the severe and trying service to which car wheels are necessarily subjected.



SECTIONAL ELEVATION OF CAR WHEEL ROLLING MACHINE.

Pictet's New Ice Machine.

One of the objects creating considerable attention at the Jubilee Exhibition in Vienna is the new ice machine devised by M. Pictet, of Geneva, who has gone to Vienna to personally superintend his exhibit and introduce this machine in Austria. In general principles the machine does not differ from others, but there are some important modifications in detail. Instead of using sulphurous acid, as in his previous machines, M. Pictet uses a mixture of sulphurous acid and carbonic acid, which has received the name of "liquide pictet." The boiling point of this liquid under atmospheric pressure is at —19° C., and at a temperature of +50° C. the pressure of the gas is only half that of pure sulphurous acid. The inventor has some theory, according to which there takes place an actual chemical combination of the molecules of the two gases when they are being liquefied under pressure; and it is due to this property that the work expended in compression is much smaller than in any other working agent. The "liquide pictet" is not inflammable, and can even be used for the extinction of fires. It has the further advantage of leaving a greasy dew upon the surfaces of the cylinder, piston rod, valves, etc., rendering special lubrication unnecessary. The generator consists of a system of seamless copper pipes communicating with a chamber, at the bottom of which the liquid enters, while the gas is drawn off from the upper part. The arrangement of pipes is such as to facilitate an efficient circulation throughout the whole of the generator. The pump is provided with clack valves; but to avoid the risk of breakage, each valve is controlled by two springs, one pressing it down on its seat and the other acting as a stop when it rises.

Snake Bite and Yellow Fever.

Dr. Urias da Silveira has sent to the Medico-Chirurgical Society of Rio de Janeiro a quantity of a vegetable substance which is very common in the provinces —Minas geraes and Barra mansa—and which, he says, he has used with great advantage in the bites of cobras, especially during the period in which the most serious symptoms—hemorrhages and ataxo-adynamic phenomena—appeared. He points out analogies between the effects of snake bite and of yellow fever, both of a symptomatic and pathological nature, and suggests that the drug he sent should be tried in cases of yellow fever.

How Iron Rusts.

At a recent meeting of the Iron and Steel Institute, an interesting communication was read on the chemical processes involved in the rusting of iron, by Professor Crum Brown. It was explained that the necessary conditions for the production of rust are —first, metallic iron; second, liquid water; third, oxygen; and fourth, carbonic acid—both the latter being dissolved in the liquid water. Water in the vaporous condition, even in the presence of carbonic acid and oxygen, does not affect the metal, except at high temperatures, as in the formation of magnetic oxide of iron. Liquid water with oxygen dissolved in it does not act at ordinary temperatures on iron. This is shown by the fact that ordinary water exposed to the air does not rust iron if the water contains a substance such as lime or caustic alkali. As soon, however, as the lime or alkali is carbonized, the water and carbonic acid begin to act upon the iron, the first result being the formation of ferrous carbonate, which subsequently is changed to bicarbonate and dissolves, and then to reddish brown ferric hydrate. As in this process the carbonic acid gas is first absorbed and then given off again, the continuation of the process of rusting is not dependent on new carbonic acid absorbed from the air, but the original carbonic acid can carry on the process indefinitely, as long as liquid water is present, and oxygen is supplied from the air. Once the process is started, it goes on rapidly because the porous rust not only does not protect the iron, but favors, by its hygroscopic character, the condensation of water vapor from the air as liquid water. A piece of iron, therefore, which has begun to rust will continue rusting in an atmosphere not saturated with water vapor, an atmosphere in which a piece of clean iron will not rust, because liquid water will condense from such an atmosphere on the hygroscopic rust, but not on the bright iron.

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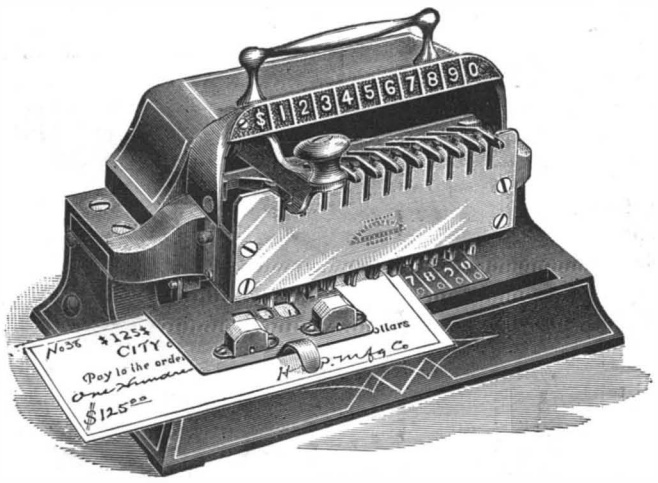
AN IMPROVED PUNCH FOR BANK CHECKS, ETC.

A simple and positive feed motion little machine, for punching out of checks figures representing the amounts for which the checks are drawn, is now being put on the market by the patentees, the Lowdon Bank Punch Company, of Kansas City, Mo., and is illustrated herewith. One of the principal advantages of the machine is the rapidity with which it can be operated, which is claimed to be twice that of other machines of

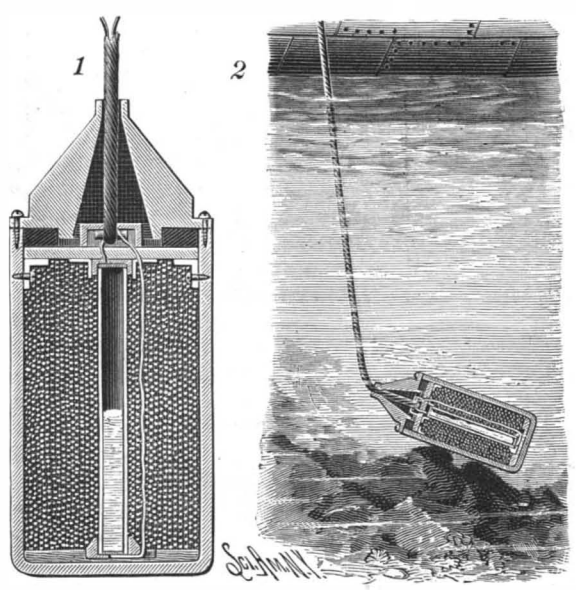


THE LOWDON BANK PUNCH.

this class. The dollar mark is on the left, and it is punched before and after the amount. In the machines made for the English market a star takes the place of the dollar mark, and is punched before, after, and to separate the pounds, shillings, and pence. The best of material and workmanship are employed in getting up this machine, which is also sold at a materially lower figure than the rotary machine. The Hoggson & Pettis Manufacturing Company, of New Haven, Conn., are the manufacturers of and Eastern agents for the machine, and also have the control of its sale in foreign countries.

IMPROVED ELECTRICAL SHOAL WATER INDICATOR.

A simple and efficient electrical device for taking soundings, and giving an alarm on board a vessel when it approaches shoal water, is illustrated herewith, and has been patented by Messrs. Pedro Vigil and Juan N. Revueltas, of the city of Mexico. The body of the sounder is a metal cylinder, with its bottom wood-lined and chambered to receive a central socket in which is inserted the lower end of a tube made of insulating material, preferably glass, closed at its upper and lower ends by disks of conducting material, the tube being about half filled with mercury, as shown in the sectional view, Fig. 1. Brackets on the inner surface of the cylinder support a plate having a metallic collar inclosing an elastic packing which covers and seals the top end of the tube, the rest of the cylinder being filled with shot, to hold the sounder perpendicularly in the water. A conical head is fitted to the sounder, and a cable passing through it, carrying two electrical conductors, is attached to the top plate within the cylinder, one of the conductors being connected with a disk closing the top of the mercury tube, while the other conductor is connected with a similar disk at the bottom. The cable communicates with a battery and sounding device, such as an electric bell, upon shipboard, and, the sounder being suspended therefrom, normally maintains its vertical position until the vessel approaches a reef or reaches shoal water, when it



AN ELECTRICAL SHOAL WATER INDICATOR.

turns upon its side, establishing electrical communication between the disks, by which an alarm is sounded on board the vessel.

For further information relative to this invention, address Mr. Pedro Vigil, No. 4 Providencia Street, City of Mexico, Mexico.

The Harvest Moon.

The harvest moon this year is that which is full nearest the 23d of September. This year it is the moon which fulls September 20. Instead of the ordinary difference between the time of rising, reaching sometimes nearly to an hour, this moon, at the time of the autumnal equinox, to those in high latitudes rises for several days in succession with an interval of only a few minutes, thus really giving much more moonlight than at any other season of the year. In the earlier days, when labor was scarce, and the interruptions to the gathering of the harvest from heavy rains were frequent, the blessing of a full moon rising within the same hour for three successive days was heartily appreciated by those in northern latitudes, and the simple-minded peasant, not understanding astronomy, supposed it was a direct intervention of the Deity in his favor. This only occurs at this period of the year. The moon is always opposite to the sun when she is full, and she is full in the signs of Pisces and Aries in September and October, these being opposite to Virgo and Libra, which are occupied by the sun in that season. Any one who will study a celestial globe will see that in those two signs of the Zodiac the path of the moon is more oblique, that is, it rises from the horizon in a smaller angle than during the remainder of the year. In plain terms, the moon moving eastward in or near the ecliptic, at the rate of about thirteen degrees per day, will descend only a short distance below the horizon for four or six days in succession, that is, for two or three days before the full and two or three days after, thus giving a greater succession of early and brilliant moonlight evenings. From her position she does seem larger, also, to the eye, and thus there is a real glory in the harvest moon found at no other season of the year.—*N. Y. Journal Commerce.*

AN IMPROVED CARTRIDGE SHELL CUTTER.

A shell cutter of cheap construction, for expeditiously removing the surplus material of a cartridge shell, after

STEIN'S CARTRIDGE SHELL CUTTER.

loading and before crimping, is illustrated herewith, and has been patented by Mr. William Stein, of No. 309 Federal Street, Camden, N. J. The handle is adapted to enter the shell, a stationary cutter blade being secured in the handle a short distance from its end, with the blade projecting from the surface on one side. The blade is preferably secured in a transverse recess in the end of the handle, the recess forming a seat for the tang of the blade, a solid block, circular in cross section, being united to the handle end by a screw passing through a hole in the shank of the cutter blade and into the handle. This block forms a gauge, and one screw retains both the cutter blade and gauge in place, the surplus material of the shell being pared off by rotating the implement in the shell until the gauge comes to a seat against the wad of the cartridge.

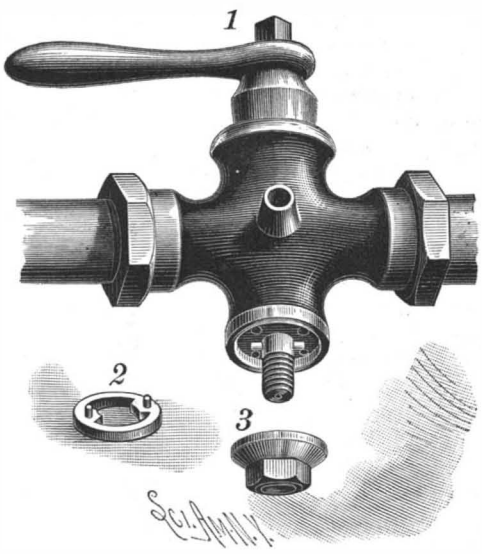
Court of Patent Appeals.

Mr. Culberson, chairman of the Judiciary Committee, has reported to the House a bill to create a Court of Patent Appeals. The bill provides that the court shall consist of one chief and two associate justices, drawing salaries of $6,000 per annum, and the proper clerical and reportorial force. The court is to have appellate jurisdiction in patent cases coming from United States courts and the Commissioner of Patents, with a right of appeal to the Supreme Court, and all pending cases now before the Supreme Court touching patents, trade marks, etc., are to be transferred to the Court of Patent Appeals.

IT is stated that plans are being prepared in the navy department at Washington for two new monitors, which, if the report is to be trusted, will be marvels of offensive and defensive strength. They are to carry a 110 ton gun, to be heavily armored, and to steam 18 knots an hour, all on a displacement of 3,500 tons.

AN IMPROVED STOP AND WASTE FAUCET.

A stop and waste faucet adapted for use either as a right or left hand faucet, making one device which may be utilized to serve a dual purpose, is illustrated herewith, and has been patented by Mr. William Briggs, of Nos. 110 and 112 Kent Avenue, Brooklyn, N.

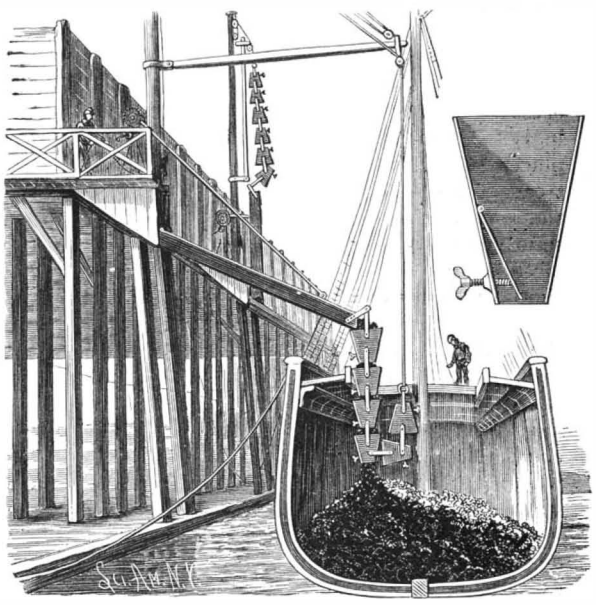


BRIGGS' STOP AND WASTE FAUCET.

Y. The key, having the usual apertures or waterways, has on its lower projecting end a reduced threaded portion to receive the usual locking nut, and in the surface of the casing surrounding the key bore are drilled four spaced apertures, the projecting end of the key having a transverse pin, or lugs on its opposing sides. A washer, shown in Fig. 2, is adapted to be placed between the nut and the lower surface of the casing, the washer having aligning lugs and integral pins adapted to enter two of the casing apertures. When the faucet is to be used as a right hand one, the washer is made to engage the casing so that the pin or lugs on the key will engage the right hand face of one of the washer lugs and the opposite face of the other washer lug. To use the faucet as a left hand one, it is only necessary to unscrew the nut and reverse the washer. If desirable, the lower surface of the casing may be recessed to receive the washer, and the apertures drilled accordingly, so that the washer will not be visible from the outside, the nut then bearing against the face of the washer and concealing it.

AN IMPROVED COAL CHUTE.

An apparatus whereby coal may be loaded from a high coal dock into the hold of a vessel below without pulverizing or breaking the coal, is shown herewith, and has been patented by Mr. John H. Du Bois, of 287 Park Avenue, Hoboken, N. J. A mast is mounted on the dock where the fixed chute is located, with a windlass for raising and lowering a hinged chute, and attached to the outer ends of the latter is a series of connected hoppers. From the lowermost hopper a rope passes over pulleys on the boom and mast, in such way that by drawing upon the rope the whole series of hoppers may be inverted, or one or more in succession, as the filling up of the vessel proceeds. The hoppers are connected together by pivoted links, and their lower open ends are of gradually diminishing area, so that the discharge from each hopper will be slower than that of the hopper discharging into it. In each of the hoppers is a plate acted upon by an adjusting



Du BOIS' COAL CHUTE.

screw, as shown in the sectional figure, whereby the discharge opening of the hopper may be increased or diminished. In this manner the drop of the coal from the chute is retarded at each hopper, or from one hopper to the other, and from the last to the hold, and all breaking is avoided.

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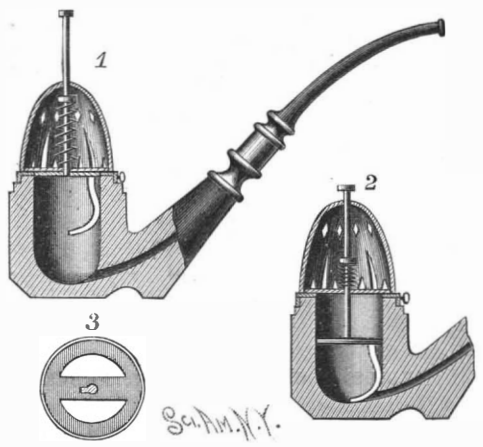
AN IMPROVED TOBACCO PIPE.

A pipe in which the tobacco can be pressed down in the bowl, or loosened if pressed too closely, and in which the bottom of the bowl can be conveniently scraped and cleaned, is illustrated herewith, and has been patented by Messrs. Thomas B. Whitledge, George W. Kenner, and Michael Rueckert, of St. Mary's, Mo. To a ring plate on the edge of the bowl is hinged a cap or lid, having air holes, this lid having at its base a web, shown in Fig. 3. A pusher rod passes through the top of the cap and the center of the web, carrying at its lower end a disk constituting a tobacco presser, this disk having perforations, while a curved bowl-

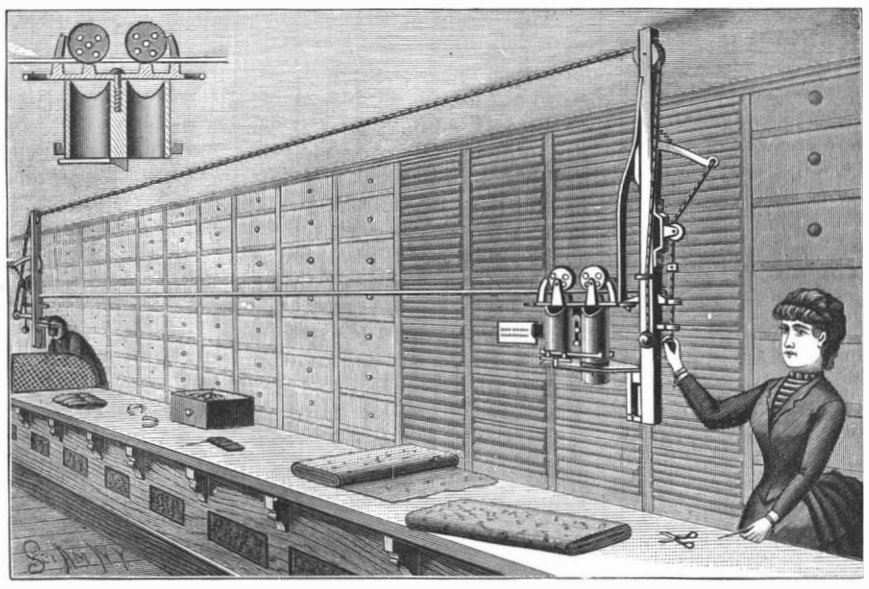


AN IMPROVED TOBACCO PIPE.

cleaner arm projects downward from its edge. A spiral spring around the pusher rod holds it normally in the position shown in Fig. 1, but the rod has a shoulder adapted to engage a slot in the web at the base of the lid, whereby it may be held in the position shown in Fig. 2, for the partial rotation of the cleaner arm in the bottom of the bowl.

AN IMPROVED STORE SERVICE APPARATUS.

A carrier for cash, messages, and parcels, etc., from one place to another in a store, is illustrated herewith, and has been patented by Mr. Hubert Hebert, of Lake Linden, Mich. Between a post located near the cashier's desk and one in another part of the store is stretched a track formed of a rope or strip of any suitable material, a suspended carrier traveling on this track by means of grooved wheels. On the bottom of the plate to which the wheels are secured are the downwardly extending compartments of the carrier, as shown in the sectional view, both open at the bottom, and having side openings near the top for inserting money or parcels. On the lower ends of the compartments is held a bottom adapted to cover one or the other of their open ends, the bottom being held to slide longitudinally on guideways, and being locked in place by bolts sliding vertically. On the front and rear of the bottom are downwardly extending lugs adapted to engage the front and rear edges of plates secured to the posts, preventing the bottom from moving with the carrier as the latter nears the end of its route, a short tube on the inner end of each plate being adapted to register with the open lower end of one of the compartments. On the top of the plate to which the grooved wheels are secured are lugs against which operate the free ends of vertical springs secured to each of the end posts, the springs being acted upon by levers fulcrumed on the posts, the cords connected with the ends of the levers having dependent balls or



HEBERT'S STORE SERVICE CARRIER.

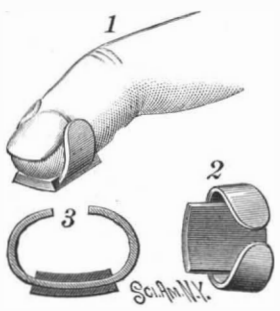
handles within easy reach. Each of these cords also has an attached block adapted to release a catch by which the carrier is held in locked position, when the pull on the cord has put the propelling spring under sufficient tension. The cord extending from one post to the other near the ceiling is so connected that the operator sending the parcel, etc., at a distance from the cashier's desk, can bring the carrier back again. As the carrier in its forward movement nears the cashier's desk, the downwardly extending lugs on its bottom engage the edges of the plate attached to the post, so that the bottom is held while the carrier moves forward the width of one of its compartments, its open compartment then registering with the tube over the desk, so that the parcel or money drops out. On the post at the cashier's desk there is, also, a pin adapted to open a spring clamp secured to one of the compartments of the carrier, the clamp being adapted to hold written messages, which are released by the contact of the carrier with the pin, so that the message drops out on the desk.

A Village Destroyed by Ice.

Advices from the fishing village of Kerschkaranza, in Kola, a peninsula on the White Sea, describe a wonderful phenomenon, new in Arctic annals, which took place on January 5th last. At 4 o'clock in the morning the inhabitants were awakened by a series of heavy, dull detonations, like heavy artillery. Shortly afterward a great ice wall to the northwest, several hundred feet high, was seen to be moving toward the village, doubtless in consequence of the pressure of the ocean of ice outside. The ice hills came slowly but irresistibly onward, and passed over the village, which they completely erased, and kept onward for a mile inland. The ice traveled a mile and a half in four hours. The villagers saved their lives, but little else.—*Philadelphia Press.*

A FINGER SHIELD FOR MUSICIANS.

A simple and inexpensive device for the protection of the fingers of musicians while playing on stringed instruments, such as the guitar and harp, has been patented by Mr. Anton Ahlquist, of Ishpeming, Mich., and is illustrated herewith, Fig. 3 showing the device in transverse section. It consists of a curved strip of metal adapted to receive the end of the finger or thumb, and provided with a covering of leather or analogous material. To the outer surface of this covering is applied a mixture of Venice turpentine and pine pitch, preferably mixed in about the proportions of



AHLQUIST'S FINGER SHIELD.

three parts of turpentine and one of pitch, the design being to thus render the playing more comfortable and insure a more positive action of the finger upon the string.

Carbons.

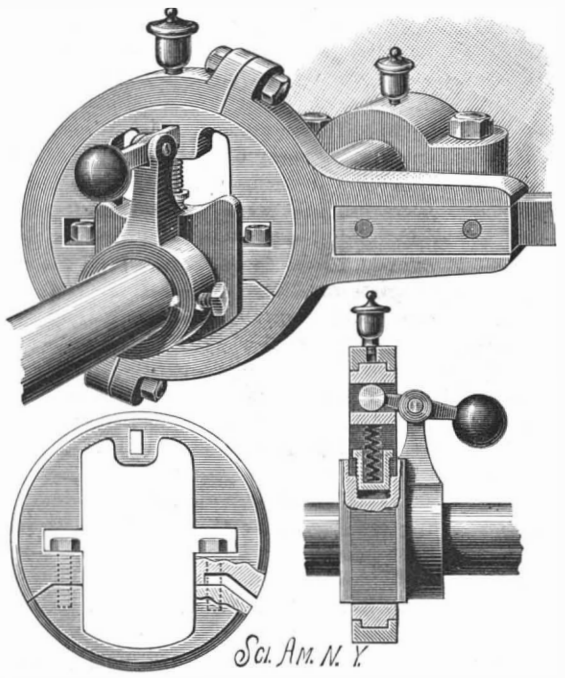
There are said to be 150,000 carbons burned daily in the electric lights used in the United States, of which 100,000 are manufactured in Cleveland, Ohio. Six years ago all the carbons burned in this country were made in a single room in Boston. Now there are twenty carbon furnaces in Cleveland alone. The carbons are made chiefly of the residuum of oil after it has been refined, and the deposit about natural gas wells is also coming into use. The material is ground to a powder, a little pitch is added, and the substance is then placed in moulds. These are packed in boxes and the latter placed in a furnace, where they are subjected to the most intense heat.

The capacity of an ordinary furnace is 45,000 carbons.

A BLOWER is being placed in the Shaw mill, Bath, Me., and a tunnel is being led from the mill to the electric light station, about fifty yards distant, by which all the sawdust of the mill is to be blown from the mill to the electric light station, where it will be used for fuel. There is said to be considerable rejoicing among 'longshoremen that this is being done, as for several years past the sawdust of the mill has been thrown overboard, and the depth of the river and docks has been materially lessened in consequence.

AN IMPROVED CUT-OFF VALVE GEAR.

An improved cut-off for regulating, automatically, the travel of a valve of a steam engine according to the speed of the main driving shaft is illustrated herewith, and has been patented by Mr. George B. Rait, of



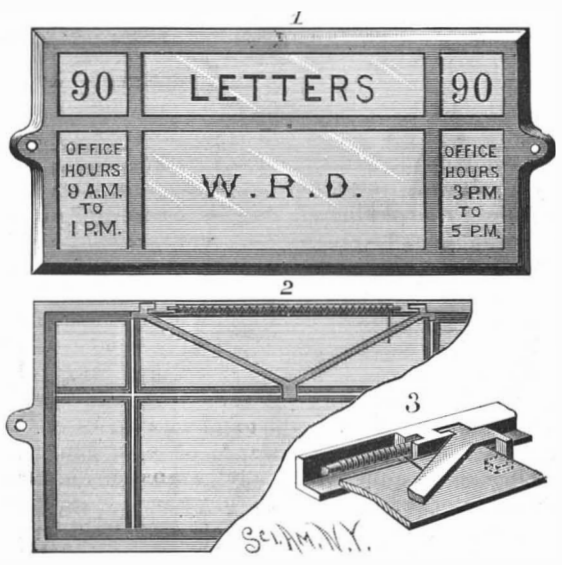
RAIT'S CUT-OFF VALVE GEAR.

Everly, Iowa. A shaft block secured to the main driving shaft has parallel ways on two of its sides in which fit the parallel side walls of an eccentric made to slide thereon, an expansion spring within the central opening of the eccentric, as shown in the sectional view, bearing against one of its end walls and against the adjacent end of the shaft block. This spring is balanced by a vertically swinging lever, mounted at right angles to the block and eccentric, weighted at its outer end, and engaging the eccentric at its inner end to throw the eccentric against the action of the spring, the latter being of sufficient tension to hold the eccentric in its proper position for the desired rate of speed.

When the speed exceeds this rate, the ball of the lever is thrown outward by centrifugal force, causing the eccentric to slide toward the center on the shaft block, and making the valve cut off sooner, thus admitting less steam to the cylinder, and diminishing the speed of the engine, until the normal point is reached. The eccentric is preferably made in two parts, as shown in one of the views, fastened together by bolts and rivets, for convenience in placing on the guideways of the shaft block.

AN IMPROVED LETTER BOX DOOR PLATE.

A door plate adapted to serve for the name and number, to show office hours, or give other information, and also adapted for use as a letter box door, is illustrated herewith and has been patented by Mr. Rolf Stafsvick, of No. 187 North Morgan Street, Chicago, Ill. The frame is formed of a rectangular casting, arranged to furnish such compartments as desired, the exterior as well as the longitudinal and transverse bars of the frame being rabbeted on the back to receive glass panels. In the back of the upper bar are formed right-angled recesses for receiving the pivotal ends of a Y-shaped frame, as shown in Figs. 2 and 3, the pivots being held in their places by setting the metal of the frame



STAFSVICK'S LETTER BOX DOOR PLATE.

partly over them. In a recess in the back of the top bar is a rod which supports a spiral torsion spring, one end of which rests upon the Y-shaped frame in such manner as to press it in the direction required to close the letter box door, behind which, inside the door, the letter box is arranged.

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Scientific Research.*

"In the early years after the foundation of the government, a few great men were interested in the philosophy of science, in its facts, and in research. Franklin was a physicist, Jefferson a naturalist, and Gallatin an anthropologist. These and other great men of the time drank deeply at the fountain of science; but they were statesmen, or they had other callings and made the advancement of science a secondary purpose. But slowly scientific men rose, one after another, who devoted their entire energies to research. In the last generation a galaxy of great scientific men appeared in the American firmament: Henry, Bache, Pierce, the Rogers brothers, Gray, Baird, and many others. These men devoted their lives to research and instruction in science. In 1840 they organized the Association of Geologists and Naturalists, and in 1848 they transformed that society into the American Association for the Advancement of Science. Since that time the society has embraced in its membership all or nearly all of the scientific men of America, and in the list of its officers—presidents, vice-presidents, and secretaries—the names of many of the illustrious scientific men of the country are enrolled.

"Most of the great men of that generation have sailed away on the unknown sea. A few only, like Dana, Hall, Newberry, and Lesley, remain to guide in our councils and to cheer on the labors of the present generation of investigators. The society which they organized has grown with the growth of the country and the far more rapid growth of science, until it embraces a membership that constitutes a vast corps of laborers who occupy the border land of knowledge, which is the field of research. To enumerate in systematic order the fields of research occupied by the various members of this association would be to formulate a classification of the sciences.

"Atoms, mountains, and worlds, with all inorganic bodies and all inorganic motions, are to be examined in the study of the inorganic realm. The phenomena of nature are qualitative and quantitative, and out of quantitative relation the abstract science of mathematics has been developed, and this science of measurement is rapidly being applied to the qualitative sciences. There are many men engaged in mathematical researches. There are members who study the stars, compute their distances, and determine their courses, and who are seeking to solve the mysteries of the constitution of the bright sun and the pale moon; for on the chariot of light they drive through the storms of the greater orb and explore the dim fields of the lesser. Others with patient labor seek to discover the nature of light, of electricity, and of gravity—the mysterious force that impels the universe. There are others, many others, who are investigating the minute constitution of matter and determining its many forms. These forms are forever changing. The crystals of the rocks that make up the mountain mass are dissolved and their atoms redistributed in new forms, and chemical changes are in progress wherever human investigation can penetrate. The tree grows and decays, and man is but a form—a mould, through which streams of atoms pour in waves of chemic change. So the chemist studies the laws which govern the constitution of bodies and under which they are forever flux. There are others who are studying the molar motions and mechanical powers by which waters are made to turn mills, winds to waft vessels, and steam to drag cars. There are others who study the atmosphere which bathes the earth. They study the coming and going of storms, where fierce cyclones are born, how the cold wave creeps from polar regions, and the hot wave from the tropics. There are others who are studying the surface of the earth—the lands and seas in all their places and forms. At the far North there is a region walled by ice, a million and a half square miles in extent; but even into this land of ice they penetrate. About the South Pole there is an area of seven million square miles inclosed by a barrier of ice—an unknown region into which the modern scholar is bound to enter. Between these walls the whole habitable earth is spread, and they are exploring all its seas, navigating all its rivers, climbing all its mountains, and threading all its canons.

"A great army of men is engaged in the study of the constitution of the earth—the origin of mountains and valleys, of hills and prairies, of volcanoes and geysers, of cataracts and caves, and of rivers and lakes and seas. They examine the great coral reefs and islands of the sea, and they study the great coral rocks of the land—the fossil reefs and islands of ages gone by. Climbing among cliffs, they study the anatomy of dead volcanoes, and climbing to the brink of craters, they study the physiology of living volcanoes. If an earthquake rends the rocks, they measure the vibrations of its waves, and with the eye of science penetrate to the center of the disturbance, and draw upon their maps the lines of weakness in the crust of the earth. They follow the sands that are washed by storms from the mountain sides until they find them built by the sea into islands and coasts. With microscope and crucible they study the constitution of granite, basalt, trachyte, and other rocks, wherein appear the crystal forms of many minerals. They show that the grand mountain form, with its crags, and peaks, and grottoes, where forests stand, where lakes are embosomed, and where cataracts flash in the sunshine, is indeed an aggregation of many gems beautiful in form and brilliant in color.

"But man is not satisfied with the knowledge which comes with the study of the inorganic realm; he essays to solve the mysteries of life. An army of men is engaged in the investigation of vegetable life. They find minute but beautiful plants that grow as dust on polar ice; in dank fields they find fungi, on rocks they find mosses, on the waves they find sea weeds, on tropical trees they find orchids, on the prairies they find asters, in the savannas they find lilies, in the jungle they find palms, in the forests they find oaks, on the mountain flanks they find sequoias; and they study all these forms and a thousand more, and out of their study grows the science of botany. Then they must know how these forms became, and they trace their origin in the dim past, and they exhume the forms of plant life from the tombs of ancient meadows and groves.

"Then another army of men is engaged in the investigation of animal life, and they find the land and sea teeming with varied forms. In the sea the coral animals grow and build their weird structures. On the bottom and shores of the sea mollusks crawl, carrying with them their pearl-lined homes. There are mollusks in all the lakes, in all the rivers, in all the brooks, and in all the ponds, and they wander over the lands and climb the trees. On the lands there are crawling worms, and in the seas crawling articulates, and the world is covered with crawling insects. The ants live in cities of their own building, the bees live on the clover blossoms, and the butterflies play among the roses. The fishes swim in the waters, the reptiles crawl in the marshes, the birds fly in the air, and the beasts roam over the land. These animal forms are studied and classified, and we have systematic zoology. But this is not all of zoology. In the life of every living thing there is a wonderful history of transformation; so zoologists study the birth, growth, and death of animals. Then they discover the origin of present tribes, by investigating the forms of life that have existed in the past, and they call upon the rocks to reveal their evolution.

"Man essays to learn the marvelous structure of the human form, and the working of this complicated organism, and the processes by which the materials of the world are transformed into brawn and brain, and by which the powers of the dead universe are transformed into life. This study gives us the science of human biology. Having learned how men live, scholars seek to learn how men may live longer. In his quest to know, man has transformed plains into fields, prairies into gardens, forests into orchards, tribes of wild beasts into herds and flocks; he makes the cataract his slave, and laughs at the lightning; the multitude of enemies by which he was once surrounded have now become his friends; in his puissance he seems to have conquered all; but while he has subdued many of his great enemies, he is surrounded by hosts of infinitesimal foes. He fears no attack of the lion, but he surrenders in death at the attack of the microbe, yet by light of science he seeks to disarm and destroy these infinitesimal foes.

"Man is an animal in body, stomach, and legs; but then he is an animal with opinions, and forever he has been systematizing these opinions into philosophies. In the earliest philosophy everything was endowed with life and deified—stones, trees, fountains, forests, beasts, winds, waves, and stars; and the mysteries of the universe were explained by making all these things intelligent actors. From this, the earliest philosophy of the lowest savage, it is a long way to the philosophy of science, and there have been many stages. That hollow dome, the firmament, has become infinite space; the wind, that was at first believed to be the breath of beasts stationed at the four corners of the earth, has at last become the circumambient air in motion under physical laws; the flat space of earth has become a globe; astrology has become astronomy; alchemy has become chemistry; witchcraft has become medicine; beast gods have become domestic animals; and nature gods have become energies that can be used as the servants of man. The history of these opinions and of the philosophies into which they are woven is now a theme for the investigation of many men.

"So the members of this society are prosecuting investigations in the realms of motion, life, and mind; and there is such a division of labor that every great science included in these realms has its devotees. It is a goodly work, it is a grand work."

*From the address of Major J. W. Powell, Director of the United States Geological Survey, delivered as President of the American Association for the Advancement of Science at the Cleveland meeting, August 15, 1888, as reported in the *Electrical Engineer*.

WE have received from Mr. W. H. Mowrey, photographer, Milford, Mass., a couple of instantaneous photos. of railway trains stated to be moving at the velocity of 40 miles an hour. The details are excellent and the pictures very pleasing.

Correspondence.

The Barnard-Brooks Comet.

To the Editor of the Scientific American:

The comet discovered by Barnard, September 3, was independently discovered by me the next morning, September 4. My discovery was promptly announced by telegraph the same morning to Dr. Swift, of the Warner Observatory, Rochester, the news of Barnard's discovery not reaching me until this morning, twenty-four hours after my telegram of discovery was sent.

The comet is near the head of Monoceros, and is only visible in the early morning sky with good telescopes.

It is rather faint, round, with some central condensation.

WILLIAM R. BROOKS.

Smith Observatory, Geneva, N. Y., Sept. 5, 1888.

Electricity in the Blacksmith Shop.

To the Editor of the Scientific American:

I wish to suggest through your valuable paper an easy and, I believe, novel means of testing the condition of horses' feet.

Take a battery or magneto machine, one that gives a light current, say such as can only be felt with moist hands. Attach one terminal to the animal's bit, the other to the shoe. If the horse suffers from the shoe or nails, he will squirm under the test. If there is no irritation, it will pay no attention to it. A little electrical science in the blacksmith shops would locate much suffering.

J. C. HENRY.

San Diego, Cal.

An Insect Cloud in New York.

To the Editor of the Scientific American:

The people of Watkins and vicinity have just witnessed a very curious phenomenon. Commencing at about 4:50 P.M., and continuing nearly an hour, a storm of small insects resembling winged ants swept through and over the valley in such dense clouds as to obscure, to a great degree, the bright afternoon sunlight, and drive pedestrians from the streets to the shelter of their homes, where windows and doors were tightly closed to shut out the intruders. The storm swept rapidly northward, against a brisk breeze, and long after the main body had passed, dense but detached swarms could be seen high in air, hurrying in the same direction.

D. T. SLAUSON.

Watkins, N. Y., September 9, 1888.

The Canals of the Planet Mars.

To the Editor of the Scientific American:

I have read with some interest the paper in the SCIENTIFIC AMERICAN SUPPLEMENT of September 8, from *Science*, written by William H. Pickering of Cambridge Observatory, Mass., on the physical aspect of the planet Mars, but I think his argument in regard to the matter of the vegetable canals (?) is very weak, and to my mind he makes an absurd suggestion in regard to the possibility of these lines not being water canals. He states: "If the canals be artificial, why fill certain of them up every year, later to be reopened? Think of the labor involved covering over and then reopening a canal say 60 miles wide by 3,000 miles long, and all in the space of a few weeks." As Mr. Pickering is not an engineer, it probably does not occur to him that it may be easier to draw the water out of a canal than to fill it up, as he seems to think is necessary. This could be done in a few weeks without any trouble by the inhabitants of Mars, and when the canal was dry, it would not be visible from the earth. Again, when the water at certain seasons was let into the canal again, it would gradually reappear. This would seem to be a simple manner to account for the appearance and disappearance of the canals, and somewhat more practical than Mr. Pickering's idea that they would have to be filled up every year.

I should seriously object to contract to fill up a canal 60 miles wide and 1,000 miles long in three weeks, and I don't believe there are any contractors on Mars who would undertake the job; but to open a gate and let the water flow out is not such a serious undertaking, and would appear to produce dry land in a much more inexpensive manner than Mr. Pickering's method (which I trust is not patented).

RUSSELL THAYER. C.E., M. Am. Soc. C. E.

Philadelphia, September 7, 1888.

Silver Alloys.

Pure silver is a metal of only an inferior degree of hardness, in consequence of which silverware manufactured from the pure metal would be subject to rapid wear, and for this reason it is generally alloyed, except for articles for the chemical laboratory. Silver is more frequently alloyed with copper, besides this it is also alloyed with gold and aluminum. Alloys containing silver and nickel, or silver, nickel and zinc, are much employed in the manufacture of tableware and articles *de luxe*, which, while being of a handsome white color, are much cheaper than those from silver and copper, which was formerly much used in the manufacture of silverware.

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A GUNBOAT FOR THE GREAT FRENCH EXPOSITION.

The gunboat Farcy, after a successful trip from Lyons to Paris, in which she passed through 233 locks, cast anchor in front of the Alma bridge, where the arrangement of the port seemed to favor the proposed scheme of taking her out of the water by means of a portable railway, in order to carry her to the Palace of Industry.

This very interesting operation was performed with complete success, on the 25th of July, in the space of a few hours, and some idea of it is given in our engraving.

The gunboat Farcy, which was built in 1886 by national subscription, is 65 feet in length and 16 in width. She carries a 5½ inch gun weighing 13,200 pounds. Her draught is but 2 feet, and this permits her to navigate in water of but slight depth. She passed without trouble through all the locks of the Bourgogne, Yonne, and Upper Seine canals, the narrowest of which is but 16 feet, and made her trip without the least accident, stopping only near Corbeil in order to allow the engineers of the Decauville works to study the arrangements to be made in order to remove her from the water at Paris and take her to the Palace of Industry—an operation that we should not have thought possible had we not ourselves witnessed it in its minutest details.

We shall not describe the Decauville track, which is sufficiently well known, over 4,000 miles of it having been put down in various parts of the world. The improvements made in it by Mr. Decauville in recent years permit of the carriage of 34, and even 48 ton guns on a two foot gauge, which has the great advantage over broader gauges of allowing of curves of very short radius—say 25 feet with traction by horses, and 65 feet with traction by locomotive—while the 3¼ foot gauge does not permit of the practical use of curves having less than 150 feet radius. A track of this type was laid on the bottom of the Seine, and extended to the top of the incline at the entrance to the Alma bridge. Two three-axled 9 ton cars having been sent down this track into the water, the gunboat was placed directly over them, and, as soon as she bore upon the first, a strong tackle, actuated by three horses, began to haul her out of the water. A few minutes thereafter, her stern bore upon the other car and she then began to ascend the incline. Reaching the top, a portable Decauville turntable changed her direction nearly at right angles, and, in a few minutes, she crossed the bridge where our artist has represented her.

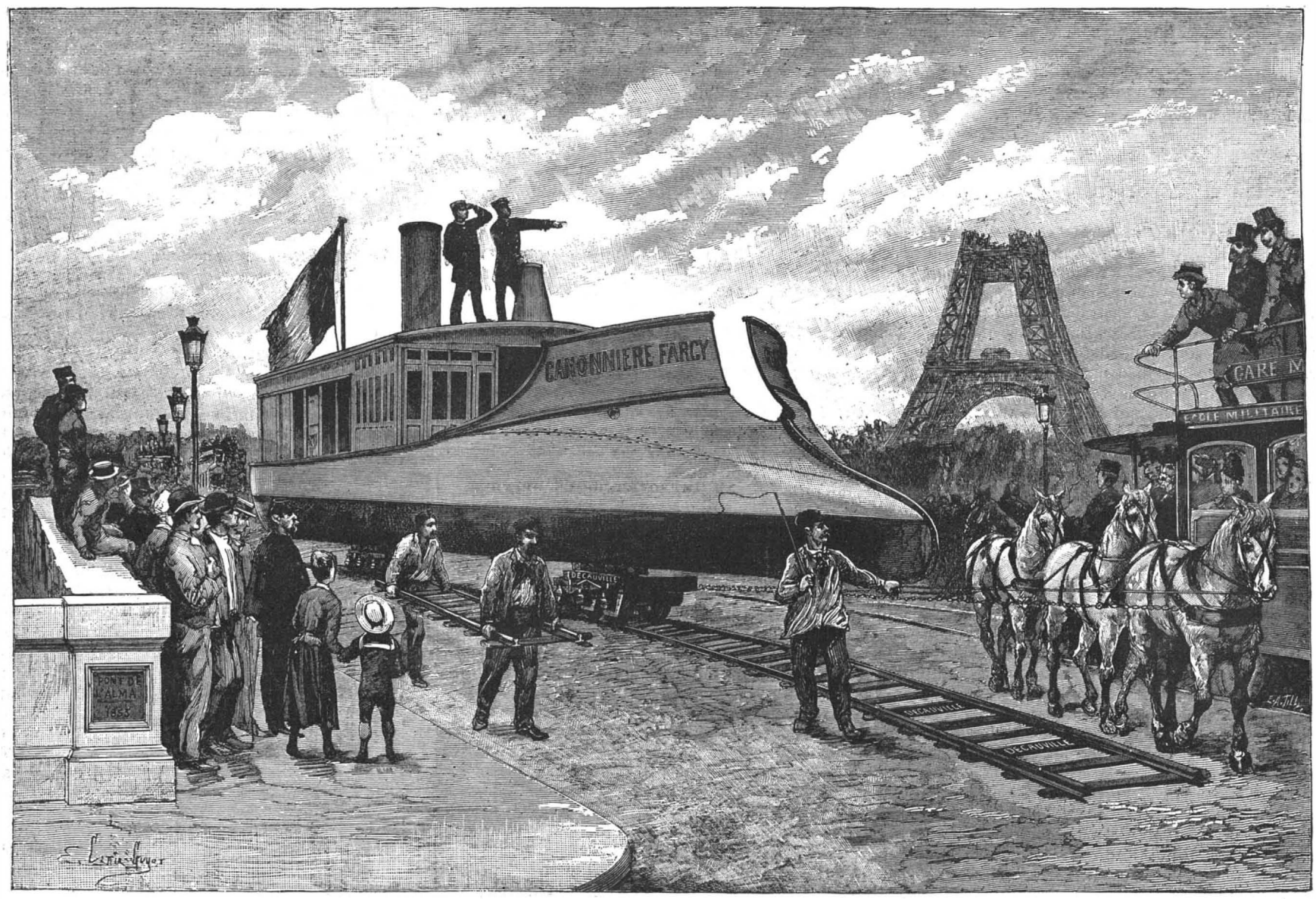
The distance to be traversed between the bridge and the Palace of Industry was 2,000 yards, but, as there was but a single carriage to be effected, Mr. Decauville found it preferable to use but a thousand yards of track, which was taken up behind the boat in measure as she advanced, and was laid down in front.

The laying of the Decauville track was done so rapidly that, when no obstacle presented itself, it was effected at the rate of 1,500 yards per hour with a force of eight men; but it was necessary to stop frequently, so as not to interfere with the passage of the tramway cars, which are very numerous on the Alma bridge, and the total operation lasted fifteen hours.

On arriving at door VI. of the Palace, near the Ledoyen restaurant, it was found that the boat was too wide to enter, and the managers of the exhibition hesitated at the expense of laying her upon her side and taking her in in that manner. To avoid swelling the expenses, Mr. Farcy proposed to introduce her on her keel, with a slight injury to her sides or a slight scratching of the door frame, for it needed an extra space of but six-tenths of an inch to allow her to enter and take her place upon the large basin constructed in the center of the Life-saving Exhibition. All applications made to the Ministry of Fine Arts, however, were fruitless, and the authority to scratch a few stones or displace them for a few days was pitilessly refused. The gunboat, therefore, had to beat a retreat for a few feet, so as not to interfere with traffic in this part of the Champs Elysees, and it was decided that she should remain outside of the Palace of Industry upon the Decauville railroad that had transported her.

Parisians, then, are going to have, during the whole summer, the somewhat rare spectacle of a ship railway, which will give them some idea of what the Americans wish to establish as a competitor at Panama.

Let us add that Commander Farcy has decided to allow his gunboat to be visited upon the payment of an entrance fee, the amount thus collected to go to the Fraternal Society of the Old Defenders of the Country. —*L'Illustration.*



THE FRENCH GUNBOAT FARCY EN ROUTE FOR THE PALACE OF INDUSTRY, PARIS.

Death in Bed Bolsters.

A medical officer of the health department was speaking recently about the danger that lurks in diseased bed clothes, to a *Mail and Express* reporter.

"Take notice," he said, "of the fact that disease and death lurk in the very pillows and bolsters on which we lay our heads at night. It is easy to talk of down and feathers, but it is a fact, if they were cut open, these articles would be often found to be more or less stuffed with the most heterogeneous materials. Pillows, bolsters, and beds have been examined and found to contain portions of filthy, coarse black serge, apparently parts of soldiers' coat sleeves, pieces of dirty, greasy silk dresses, old worsted braid from the borders of women's gowns, soiled linen rags and colored calico, and even nuts and walnut shells and pieces of crinoline wire. The bedding in this case was bought new, we are assured, a few years ago of an expensive and respectable upholsterer. Moreover, a woman who was employed to do the unpicking work of the trade informed the lady of the household that the practice of stuffing bedding with dirty rubbish and rags was very general, and that few beds or bolsters contain only the materials of which they are supposed to consist."

Spraying Bartlett Pears.

The practice of spraying or faintly showering young fruit with liquid poison, to destroy the noxious insects which injure it, has for many years been practiced by successful fruit growers. It has proved particularly advantageous to apples and pears, and more especially to the Bartlett pear, which from its earliness and texture appears to be particularly liable to the attacks of the codling moth and of the curculio. The work is done when the young fruit stands erect, ready to hold the poison in its upright cup, and when the young pears are between the size of peas and of cherries. It is sometimes necessary to repeat the operation two or three times, to replace what may have been washed off by heavy rains. The most commonly used poison is Paris green, thoroughly mixed and stirred with 700 times its bulk of water, and faintly and universally showered over the whole tree. It destroys all the codling worms, just hatching in the calyx where the moth has laid its eggs, and long before the pears are half grown the rains have washed off all the poison, so that it is perfectly safe to eat the fruit when mature.

Paris green is a very imperfect remedy for the curculio on plums, and usually destroys only a part, but it seems to be more efficient on pears, and, together with the codling moth, this remedy does valuable work on them. We have had an opportunity the present season of comparing, or rather contrasting, the two modes of treatment. An orchard of Bartlett pears was sprayed three times, the rains partly interrupting its action. The result now is that the heavily loaded trees are bearing scarcely a defective specimen, while a tree, likewise heavily loaded, growing forty rods distant in a garden, has nearly every pear more or less distorted and disfigured by the codling worms in the calyx and core, and by the curculio at the sides.

We have described more in detail the process of spraying in our past numbers. London purple, if pure, and when not choking or obstructing the fine spraying rose, answers as well as Paris green, and some orchardists have used the white arsenic, which they find cheaper and quite as efficient, but it is considered more dangerous than Paris green, because it does not exhibit so distinctly, in any vessel in which it has been used, its peculiar and conspicuous green color.—*Country Gentleman.*

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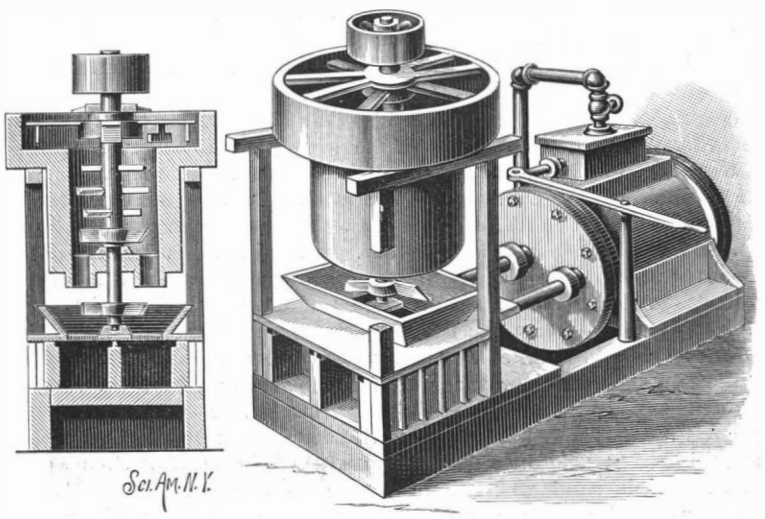
New Observatory.

Denver is about to have an astronomical observatory that will rival the famous Lick Observatory in California. Its dome will rise from a plain and have 1,000 feet greater elevation. The building and instrument have been provided for through the liberality of W. B. Chamberlain, of Denver. The framework of the metal dome is of iron and steel, and is made as light as is consistent with a high degree of rigidity. The covering is of galvanized iron. The weight of the dome will be about twelve tons, and the devices for making it revolve easily are very ingenious; the endeavor is to substitute rolling for sliding friction. For this purpose a live ring is employed. This consists of a number of wheels set at equal distances around a circular track; on the circumferences of these the dome rolls. The telescope, which is now being completed, will be a very valuable and expensive instrument. The diameter of the object glass will be 20 in. and the length of the tube about 26 ft., of the best hard rolled steel.

AN IMPROVED PUG MILL.

A mill designed to thoroughly and economically mix and grind clay, and force the tempered clay into the mould box of a brick machine, is illustrated herewith, and has been patented by Mr. Henry Woodcock, of Perth Amboy, N. J. On the base of the machine is mounted a steam cylinder, together with a frame supporting the receptacle in which the clay is worked and tempered. This receptacle has a circular pan at the top, below which is a cylindrical mill, in the bottom of which are two passages through which the clay



WOODCOCK'S PUG MILL.

drops into a hopper below, in the center of which a vertical shaft is stepped. A spider frame is carried by the shaft in the circular pan at the top, the arms of the frame having blades and a scraper, to work the clay and force it into the mill below. In this mill the shaft carries arms for agitating and working the clay, and a propeller for forcing it through to the hopper, as shown in the sectional view. In the hopper the clay is further worked, and forced through passages in the bottom to boxes below, there being in each box a follower, both of them connected to the same piston head in the steam cylinder by piston rods, so that both are operated at the same time by a single steam cylinder. Each follower is provided with a plate at its upper edge to close the openings at the bottom of the hopper, when the followers are thrust forward to force the tempered clay out of the machine.

New York as a Milling Center.

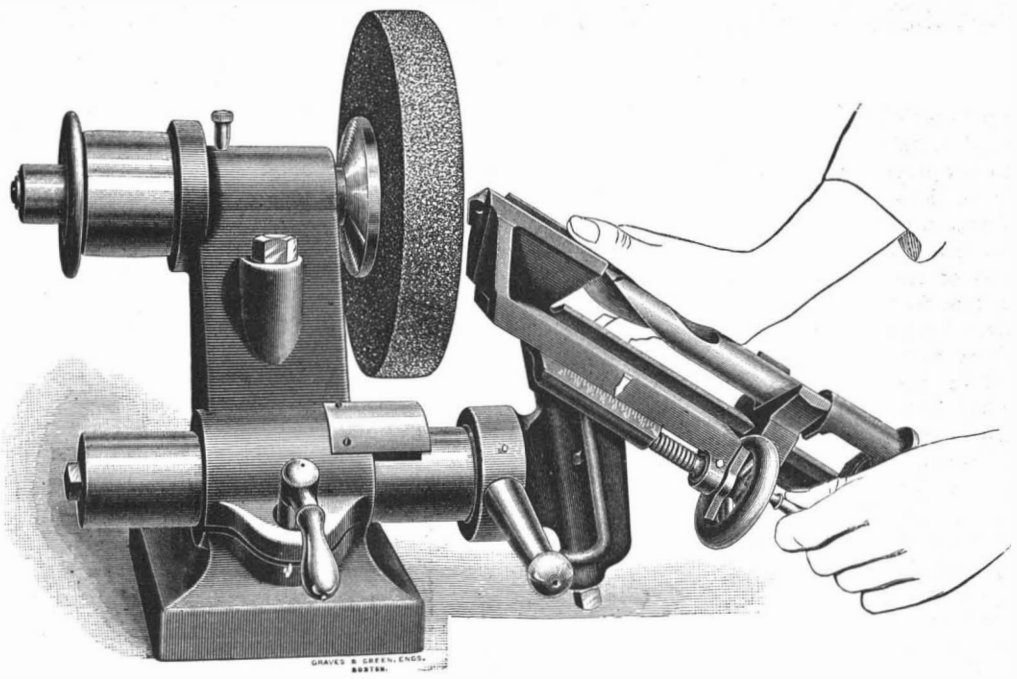
There is a steadily growing impression that New York City is destined to be one of the chief milling centers of the country ere long. There are many cogent reasons for this belief. Being the leading seaport and moneyed center of the country, with a large storage capacity, and also the natural terminus of the principal railways, as well as the Erie Canal, the available supply of wheat is generally likely to be abundant. Furthermore, as it draws its supplies from all quarters of the country, the assortment is, of course, apt to be better than ordinarily obtainable at interior points. This will assuredly give the miller a decided advantage. Loud complaint has been heard recently from the West, but particularly from winter wheat States, regarding the difficulty of obtaining supplies of wheat at prices on a parity with those current in New York. These facts have induced several gentlemen of means and experience to erect a first class mill here. Among the leaders in this enterprise are Messrs. B. B. Stewart, a well known citizen of Cincinnati, J. C. Ott, of the Produce Exchange, and William Sumner. The mill, which will be chiefly brick, and six stories high, with a daily capacity of 1,500 barrels, is now being constructed under the personal supervision of Mr. William D. Gray, the well known expert of the firm of E. P. Allis & Co., of Milwaukee. No pains or money will be spared to make this mill perfect in every respect. The location is an excellent one, being at Mariner's Harbor, on the Kill Von Kull, Staten Island. The property is 987 feet deep, 300 feet wide in the rear, and 265 feet front on the water. The dock will have 20 feet of water at high tide and 14 feet at low tide. Moreover, the Baltimore & Ohio Railroad will run tracks down the entire length of the property. This will give first-class railway as well as water facilities. Hence wheat can be delivered direct from cars or boats into the mill, and the flour out in the same way.—*Produce Exchange Reporter.*

Purification of Mercury.

The following process for the purification of mercury has been in use for some years at the Physical Institute at Kiel with the best results. The mercury containing chemical and mechanical impurities is poured into a glass tube, into the lower end of which is cemented a piece of bamboo cane which acts as a filter. The mercury passes through this into a larger glass tube almost entirely filled with dilute nitric acid (1 in 50), and on leaving this bath is sufficiently pure for some purposes. The distilling apparatus to prepare chemically pure mercury consists of a glass tube about 15 mm. wide and 80 cm. long, at top of which is a bulb of about 6 cm. diameter. The open end of this tube is placed in an inverted bottle with the bottom knocked out. Through the cork in the neck of this bottle is passed a second tube about 1 cm. wide and 145 cm. long, which passes through the other wider tube and up into the bulb at the top of it. This narrower tube is also contracted into a capillary one about 40 cm. from the top, and at the lower end is bent upward. To work the apparatus, the wide tube and bulb are filled with mercury and inverted, which creates a vacuum in the bulb, and more mercury is poured gradually, drop by drop, into the narrow tube to increase it, and the apparatus then acts like a Sprengel pump. The bulb is then heated by the flame from a circular burner, and distillation takes place continuously, the absolutely pure mercury flowing out at the bent-up end of the smaller tube. Unless the atmospheric pressure varies greatly, the apparatus can be left at work night and day, and only requires the addition of mercury two or three times in 24 hours.

AN IMPROVED DRILL GRINDER.

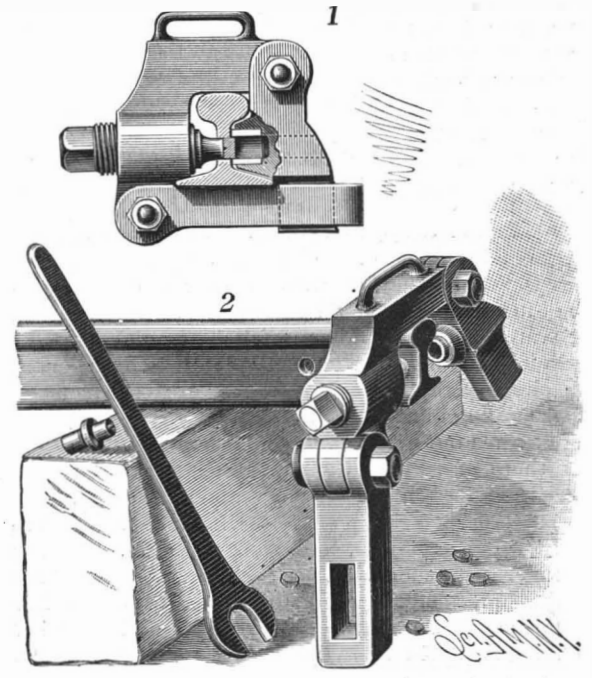
A drill grinding machine which can be sold at a moderate price, and which will hold twist drills varying in size from ¼ inch to 2 inches, is illustrated herewith, and has recently been perfected at the Washburn shops of the Worcester Polytechnic Institute, Worcester, Mass. The wheel spindle has a conical bearing, adjustable for wear, while the emery wheel is of cup form, the drill being applied so that its perfect grinding does not depend upon a perfect wheel surface, a new place on the wheel being used each time a drill is ground. The workman places the drill in the V-shaped holder, sets the pointer on the scale to a figure corresponding to the diameter of the drill, and with the thumb of the right hand places the drill with its lower cutting lip against a projecting gauge which secures its correct position. The drill holder is then pushed forward till the drill nearly touches the wheel, where it is clamped by the handle at the left. Then the grinding is done with the two hands, the correct form of the cutting lip being made by rocking the holder and drill about a vertical axis at the same time that it is fed forward by the hand wheel. The amount ground off is gauged by the left hand on the feed wheel handle. After the first lip is ground, and before the holder is backed away from the grinding wheel, a pointer is set which indicates when both lips are ground alike. There is no adjustment of chuck holders, the rest for the shank of the drill being readily adjustable, and the end stop being adjustable for any length of drill from 16 inches down to a mere stub. The drill point is ground to a helicoidal surface of 59 degrees, and the adjustment for drills of various diameters is obtained by a combination of angles in the sliding holder, giving always the right adjustment when the pointer stands at the figure on the scale corresponding to the diameter of the drill to be ground.



A TWIST DRILL GRINDER FOR GRINDING DRILLS FROM ONE-QUARTER INCH TO TWO INCHES DIAMETER.

AN IMPROVED RAIL PUNCH.

A punch for making bolt apertures in rails, and specially intended to supersede the use of the ratchet and drill for such purpose, is illustrated herewith, and has been patented by Mr. Isaac Hulme, of Yaquina, Oregon. On a downward extension of one end of the frame is pivoted a bar adapted to be brought up against the base of the rail and held in engagement with the foot of a vertical arm pivoted to the other end of the frame. This foot passes through the opening in the bar, and has an offset to engage its bottom, as shown in Fig. 1. In one downward arm a punch screw is operated by a wrench, the central line of the screw and punch coinciding with a die held on the inner end of the other arm of the frame, and made in the form of a collar opening into a longitudinal aperture in the arm. As the operator turns the screw in which the punch is fitted, bringing its outer end against the body of the rail, the die in the other arm resting against the opposite face of the rail, the punch forces an aperture in the body of the rail, the punched part passing into the opening in the die corresponding with the punch. The device is designed to be very simple and durable, and has a handle for conveniently moving it from place to place.



HULME'S RAIL PUNCH.

THE plant now employed on the Manchester ship canal includes 98 locomotives, 3,221 wagons, 51 steam navvies, 49 steam cranes, and 104 pumping and other engines, with 161 horses and 8,568 men and boys. Almost the whole of the land required for the construction of the canal has now been acquired by the company.

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A Japanese Paper Maker on Cheap Labor.

The following original notes by an eminent Japanese official connected with the Japan government mills and printing offices are taken from the English *Paper Trade Review:*

After my travels through different countries, and from what I noted with regard to the difference of wages in two places, viz., China and the United States, I am induced to say that with regard to the wages question I have clearly seen the truth of the fundamental proposition laid down by almost all political economists, that it is not trade unionism which has raised the wages of labor. Wages are only higher or lower according to the proportion of capital invested for the maintenance of working people and the number of working people in existence. In case the capital destined for the maintenance of working people is excessive compared with the number of working people existing, employers are obliged to bid against each other to secure them, and it is quite certain that the opposite will take place when the number of working people is in comparative excess to the capital destined for their maintenance. This is the only way the wages of labor are adjusted in the natural course of things.

That the United States is a most thriving country and rapidly advancing in the acquisition of riches is a fact well admitted by everybody. The capital destined for the maintenance of the industrious classes increases there so rapidly that, notwithstanding the great number of immigrants from all parts of Europe and China, the scarcity of hand labor is felt by employers every year more and more. The consequence is high wages. Holyoke (in Massachusetts) is the greatest focus of paper making in the world, and 200 tons of paper are there turned out every twenty-four hours. During my stay there of two years, four large new mills were erected, giving employment to about 600 hands at least. Paper machine tenders whom I knew were picked up as managers, and back tenders took their place as machine men. With such circumstances it is impossible for employers not to bid against each other for workmen. For a town like Holyoke an increase of 600 inhabitants in two years is not to be got unless there be an extraordinary stimulus. Thus increased capital means increased improvement of the condition of working people. Men may possibly object to receiving too high wages, but under such circumstances they will be obliged to accept the same! Under contrary circumstances, in a country where the capital existing for the maintenance of the industrious classes is sensibly decaying, it is quite absurd to expect a liberal reward of labor.

No trade union can bring about improvement in a state of things which is the natural and irresistible result of the struggle for existence. In America paper machine men earn about ten shillings a day, and rag pickers about four shillings, while provisions are cheaper than here, thus being a favorable state of things from two points of view, and making the real recompense of labor higher than in England. It is not the actual magnitude of natural wealth but its continued increase which occasions rises in the wages of labor. It is not, accordingly, in the richest country, but in the most thriving, that the wages of labor are the highest, viz., in the one which grows rich fastest.

At present England is certainly richer than the United States of America, but the wages of labor are much higher in the latter country because it is more thriving and progresses the fastest in acquiring riches. As soon as the increase of capital is stopped, the state of things changes. When capital stops increasing, population does not stop increasing. The same will progress until very low wages stop the importation of labor from other places and discourage early marriages or decrease the number of marriages by the unprofitableness of children. In fact, the multiplication of the species was so fast in the United States of America that it is said to have doubled in twenty-five years, this being due to both immigration and multiplication. Labor is there so well rewarded that a numerous family of children, instead of being a burden, is a source of opulence and prosperity to the parents. In England a young widow with four or five children would have a poor chance of obtaining a second husband, but there it is frequently looked upon as almost a fortune. The value of children is the greatest of all encouragements to marriage. Thus a liberal reward of labor encouraging marriage will tend to increase the population, to keep pace with the increase of capital, and at last, when the wages of labor become very low, so that the burden of children discourages marriage, then the population will cease increasing.

Through the wealth of a country be very great, yet if it has been stationary for a long time we must not expect its wages to stand high. The fund destined for the payment of wages may be very great, but if it be for several centuries the same, the number of people to be employed every year can easily be supplied, and at last people naturally multiply beyond the number which can be employed. High wages mean an increase in the number of marriages and consequent increase in the population. Thus at last wages come down to the lowest rate consistent with common humanity. Statistics show that when trade is good and the price of provisions low, there is an increase in the number of marriages. They also show, at the same time, that as soon as it finds the least encouragement, population never fails to increase.

Working people cannot expect a high reward of labor when their numbers are excessive. Employers cannot monopolize a high profit by simply cutting down wages.

Capital is always seeking the best attainable investment, and when any particular business is very profitable, fresh capital seeking investment is naturally introduced, creates more employment, and raises wages for that particular business. Thus the workpeople enjoy a portion of the profits of good business. In the commercial field of free competition, no one can enjoy the monopoly of good profits. If business prospers, both employers and hands should be well off together, and in the same way both should lose when trade is bad. With a natural state of things this is an inevitable condition, and it was exactly so for centuries.

From what I have said it is, I hope, clear that trade unions cannot raise wages. To intend to raise wages by trade unions is "to cast dirt up against the skies; what has been cast up will come down on your face," that is to say, it will ruin your business.

It may be said that trade unions did raise wages by compelling employers to arbitrate, but it is not trade unionism which has done this, but general prosperity in trade and business which supported workingmen's requests. Suppose, for the sake of argument, that unions do raise wages, then we have encouragement to marriage, increase of population, and the same amount of enjoyment as used to exist before.

Then comes the question of the true and permanent remedy for a low rate of wages. This question becomes more serious and important as civilization advances, and there are several opinions on this point—all different. Almost all of them advocate the breaking down of the present system of social organization, viz., to abolish private property. Without going to such an impracticable extremity, what I think working people should do is to raise the standard of living. By standard of living I mean a certain standard of comfort, etc., below which a nation or class does not venture to descend. For instance, in England, to be tolerably well fed, clothed, and lodged, is considered a proper style of living by the industrial classes. Now, in China I noticed that millions of families are living in small boats called sanpan, which expression literally translated means "three boards." The boat in question consists merely of three big boards. Their poverty is of the lowest degree imaginable, the next step downward being actual starvation. The living of a whole family in a boat 12 × 5 feet seems to be the lowest extremity to which the Chinese are willing to descend, thus showing the difference in the standard of living in these two countries.

If the English working people change their habits of living, and become capable of as low a standard of living as the Chinese boat-living people, the population of England may at length increase till it brings them down to the said level. Thus we see what influence the standard of living has upon the well-being of the British workman. Hence I say the true and permanent remedy of low wages is the raising of the standard of living, which can be accomplished by the spread of good general education. If I am not mistaken, I can safely say that for true prosperity of the industrial classes—which means the liberal reward of labor—educate your children by all means in your power instead of resorting to unionism.

The next question is, How does the high standard of living affect the cost of production in general? It may seem that a high standard of living will raise the cost of production, but this is by no means the case. The wages of labor are the encouragement of industry, which, like all other human qualities, improves in proportion to the encouragement it receives. Plentiful subsistence increases bodily strength, and hope in a man of bettering his condition animates him to exert that strength to the utmost. Where wages are high, we find workmen active.

Chinese labor is three times as cheap as that of English people, but also just as much less productive. A fact that struck me very much was the following: In Japan ordinary labor costs say one shilling per day, in England say three shillings, and in the United States of America four shillings, and yet paper manufacturers in all these three countries are paying almost the same for the production of each pound of paper.

Chalcedony Park.

Mr. William Adams, Jr., was the discoverer of the celebrated petrified forest of Arizona, now generally known as Chalcedony Park. This deposit is situated about 25 miles southeast of Holbrook, in Apache County, Arizona. The silicified trees are found protruding from the volcanic ash and lava, which is covered with sandstone to the depth of 20 to 30 feet. Sections of this fallen forest, whose only rivals are the giants of the Yosemite and Calaveras, lie around in profusion, measuring from 2 to 10 feet in diameter, containing all the colors of the rainbow, some of whose hearts are solid crystals of amethyst and topaz, and only a slight degree from the diamond in hardness. Every color found in nature or the arts is reproduced in these fallen agatized monarchs.

PHOTOGRAPHIC NOTES.

Photo-Lithography and Etching Acids.—The *Photo. News* prints the following as the actual formula now used by Dr. Eder:

Photo-Lithography; Transfer Paper.—30 grammes of gelatine and 15 c. cm. of glycerine are dissolved in 1,000 grammes of water, and the solution poured upon the paper. One-fourth of the quantity mentioned is sufficient for a sheet measuring 45 by 50 centimeters.

Sensitizing.—100 grammes of ordinary bichromate of potash is dissolved in 2,000 c. cm. of water and liquid ammonia is added until the solution becomes of a pale yellow color. The transfer paper is immersed in this solution until it becomes quite flexible.

For transfer paper containing albumen, alcohol may with advantage be added to the sensitizing bath. The formulæ then reads, 100 grammes of bichromate of potash, 1,600 c. cm. water, 400 c. cm. alcohol, and ammonia as before, until the deep orange color is replaced by pale yellow.

The paper, after exposure under a negative, is, while in the dry condition, inked with a velvet roller, and then, after immersion in cold water, it is developed with a pledget and with the velvet roller. The transfer on to the stone is effected in the usual way.

Surface Etching on Stone.—The stone bearing the image from either photo-lithographic or other transfer paper is treated in the usual way, and lightly etched with dilute nitric acid and gum. The whole stone is then covered with powdered resin, and this is rubbed in with a tuft of cotton wool. Two narrow strips of millboard are then held by an assistant, so that they lie along the sides of the stone, and so that the edges of the millboard rise about 2 or 3 mm. above its surface. Meanwhile a strip of wood of about 8 centimeters in breadth, and covered with an absorbent cloth, has been moistened with ether. It is now slowly drawn over the surface of the stone, the strips of millboard serving as guides to keep it from touching. By the action of the ether vapor the resin is softened and combined with the ink. The etching may now be completed with a stronger solution of nitric acid and gum than before.

Etching Liquid for Zinc.—1,000 c. cm. of water is mixed in a flask with 1,200 grammes of ordinary nitric acid of 40°, 80 grammes of common salt is then added, and when dissolved 300 grammes of "strong" acetic acid is poured in. Red fumes of nitrous acid are given out, and the open flask is left in an airy place for five or six days. There is then no further, or but very slight, evolution of gas, and the acid is ready for use.

The first etching is carried on with acid of from 5° to 6° Baume, and occupies from five to fifteen minutes. For later etchings the acid may be used of double the strength given, or even more.

Preserving Albumen Sensitive Paper.—At the recent English photographic convention Mr. G. W. Webster related his experience as follows, which we take from the *Photo. News:* So little has the subject been noticed of late, that I am quite prepared to believe that some of the members here present, whose patronage of photography has not been very protracted, may now hear of it for the first time. Take a pound of ordinary washing soda, and dissolve in two quarts of water; by using boiling water the dissolution is facilitated. When cold, sheets of blotting paper are dipped into it, slightly drained, and then piled in a heap with alternate sheets of dry blotting paper, the object of this addition being to permit just the right amount of liquid to be retained that will enable the paper to be readily handled, thoroughly wet porous paper falling to pieces as soon as it is lifted. Next, the paper is hung in a current of air till dry, then thoroughly exsiccated at the fire or in an oven, and stored away for future use. This we may call "soda paper." It may be employed either for preserving paper to be kept some time before being printed, or to keep prints a good color which may have to be kept in the frame over a day. For the former purpose the dried, sensitized, albumenized paper is either rolled up with soda paper, or otherwise kept in close contact with it, as, for example, by placing alternate layers of soda paper and sensitized paper in a printing frame, and pressing down as though a print upon a negative were in progress. For keeping paper white while printing for one, two, three, or more days in the hottest weather, all that is necessary is to substitute soda paper for the ordinary felt pad. Any one who has not yet tried the soda pads, and will only once attempt their use, will be surprised and pleased at the remarkable difference in color that will be seen between paper so treated and that printed under the usual conditions, when it has been in the frame for a few days. In hot weather the one exhibits very little discoloration, while the other is absolutely useless for any but the crudest of results. I have tried both monosodic and disodic carbonates in the pure, as also in commercial qualities, but the common washing soda of commerce answers every purpose.

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SIMPLE EXPERIMENTS IN PHYSICS.

BY GEO. M. HOPKINS.

The descent of a falling body along an inclined plane is governed by the same law that controls the fall of free, unimpeded bodies, *i. e.*, "the spaces traversed are proportional to the squares of the times of descent." This law does not apply to the descent of a body along any curved path. A body descending a concave path will be accelerated at the beginning of its fall. A body descending a convex path will start slowly, and will be accelerated at the end of its travel.

Three cases are here considered: First, that of a body rolling down an inclined plane; second, that of a body descending a concave circular curve; and third, that of a body descending a cycloidal curve. In the case of the inclined plane, if the body falls two feet the first second, it will fall four feet the next second, eight feet the third second, and so on. In the case of the concave circular curve, the fall of the body will be accelerated rapidly at the start, and the body will reach the point of stopping quicker than the body on the inclined plane, although it travels over a longer distance. In the case of the cycloidal curve, the body acquires a high velocity at once, as its path at the beginning is practically vertical. This curve has been called the curve of swiftest descent, as a falling body passes over it from the point of starting to the point of stopping in less time than upon any other path, excepting, of course, the vertical.

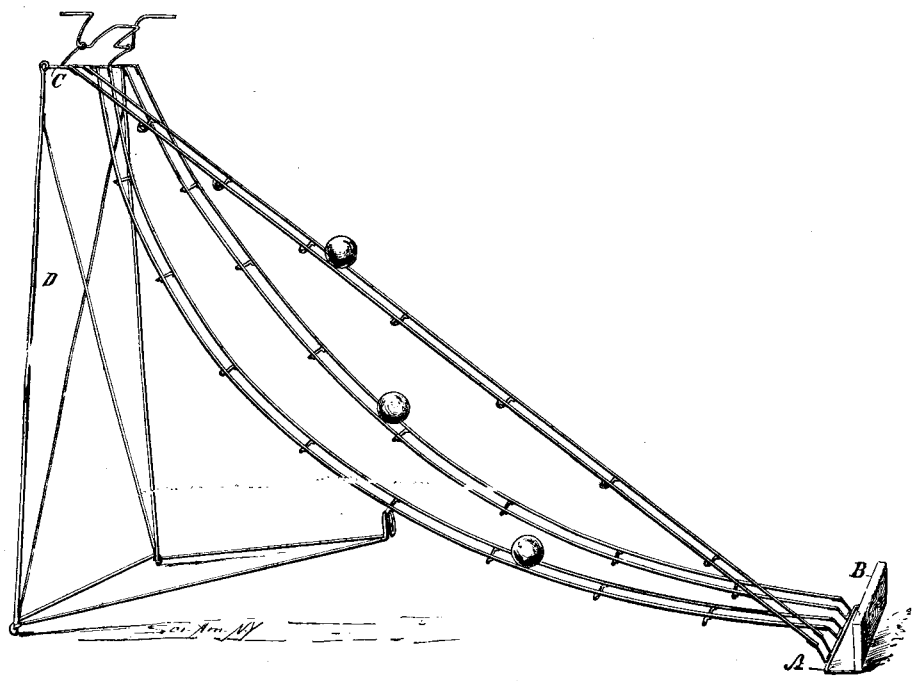


Fig. 1.—SWIFTEST DESCENT APPARATUS.

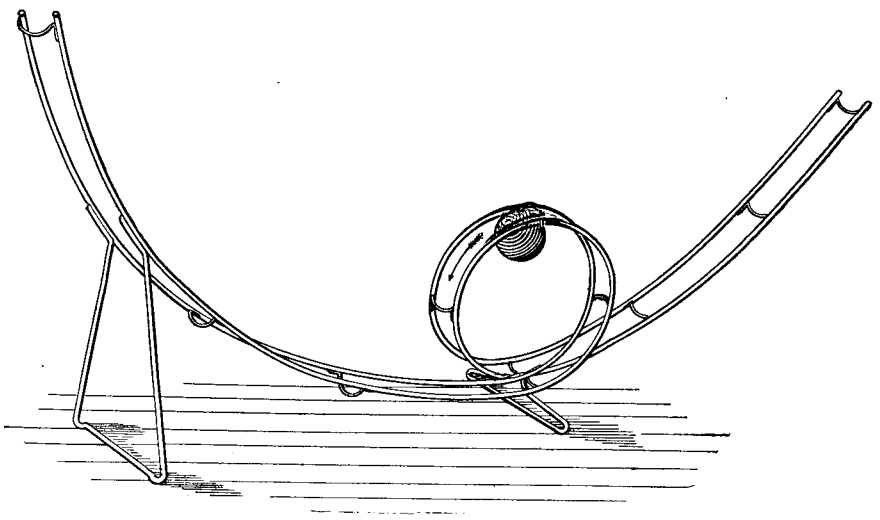
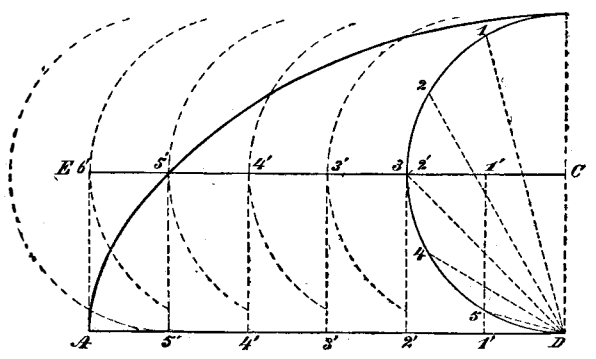


Fig. 3.—CENTRIFUGAL RAILWAY.

The cycloid has another property, in virtue of which it has been called the isochronal curve. A body will roll down this curve from any point in its length to the point of stopping in exactly the same time, no matter where it is started. For example, if it requires a second of time for a ball to roll from the upper to the lower end of the curve, it will also take one second for a ball to roll from the center of the curve to its lower end.

Apparatus for illustrating these principles is shown in Fig. 1. It does not differ much from the ordinary apparatus used for the same purpose. It is, however, made entirely of wire, and is arranged to fold, so that it occupies little space when not in use. The inclined plane and curves, down which the balls roll, are all of substantially the same construction. The rails of the tracks are formed of one-eighth inch brass wire. These rails are connected by curved cross pieces having ends bent at right angles and soldered to the under surface of the rails. The lower ends of the rails are connected by angled wires with a cross bar, A, which is bent forward, then upward, to receive the board. B, forming the stop for the balls. The upper ends of the rails are connected by angled wires with a cross bar, C, which receives the loops of the wire leg, D. To the leg is jointed a brace which hooks over one of the cross pieces of the middle track.

To the upper cross bar are soldered wire eyes, supporting a wire bent so as to form three cranks for supporting the balls, and releasing them all together. The rods of which the tracks are formed are about three feet long. The cycloid track is made first, the others being cut off to match. A method of laying out the cycloid curve is shown in Fig. 2. At the end of the base line, A D, draw the line, C D, perpendicular to A D. Describe a generating semicircle (in this case of nine inch radius) tangent to A D, at D. Draw the line, E C, parallel to the base line. Divide the semicircle into any number of equal parts—six for example—and lay off on A D and E C distances C 1, 1′ 2′, etc., equal to the divisions of the semicircle; draw chords, D 1, D 2, etc. From points 1′, 2′, 3′, etc., on the line, C E, with radii equal to the generating semicircle (9 inches), describe arcs. From points 1′, 2′, 3′, 4′, 5′, on the line, D A, and with radii equal successively to the chords, D 1, D 2, D 3, D 4, D 5, describe arcs cutting the preceding, and the intersections will be the points of the curve required. Through these points the curve is drawn and the wires for the cycloid track are bent so as to conform to this curve. The track, when completed, must sustain the same relation to a horizontal line as the curve in the diagram sustains to the base line, A D.



g. 2.—METHOD OF DESCRIBING THE CYCLOID.

Another method of describing a cycloid is to fix a pencil in the edge of a disk and roll the disk on a level surface, without slipping, with the pencil in contact with a smooth board or a piece of paper, the curve being started with the pencil at the lowest point or in contact with the base line.

A ball is supported at the upper end of each track by the cranked wire, and when the three balls are liberated simultaneously by quickly turning up the cranked wire, it will be found that the ball on the cycloid reaches the point of stopping first, the ball on the circular curve coming next, the ball on the inclined plane being slowest of all.

If two cycloidal tracks be placed side by side, it will be found by trial that a ball started from the middle or at any point between the ends of one of the tracks will reach the point of stopping no sooner than the ball started at the top of the other track. In fact, if the tracks are accurately made, both balls, if started simultaneously, will reach the bottom at the same time.

The centrifugal railway shown in Fig. 3 is made in the same manner as the tracks already described. Two wires are bent into spiral loops around a cylinder, and the extremities are curved upwardly as shown. The two curved wires are connected together by curved wire cross pieces fastened by soldering, and two wire feet are attached to complete the apparatus. No particular rule is required for the construction of the centrifugal railway. The only precaution necessary is to see that the height of the higher end of the railway is to the height of the circular part in a greater ratio than 5 to 4.

A ball started at the higher end of the railway follows the track to the opposite end, and at one point in its travel it is held by centrifugal force against the under side of the track in opposition to the force of gravity.

In Fig. 4 is shown a spiral railway upon which a ball rolls down upon a track consisting of two rails arranged vertically one over the other. The track is formed of two wires bent spirally and connected by curved cross pieces, as in the cases already described. The upper convolution of the spiral is twisted so that the ball may start on a horizontal track. During the descent of the twisted portion of the track, the ball acquires sufficient momentum to cause it to follow the vertical track, being held outwardly against the rails by centrifugal force. The descent of the ball is accelerated. The spiral railway represented in the engraving is two feet high, six inches in diameter, the rails being ¾ inch apart.

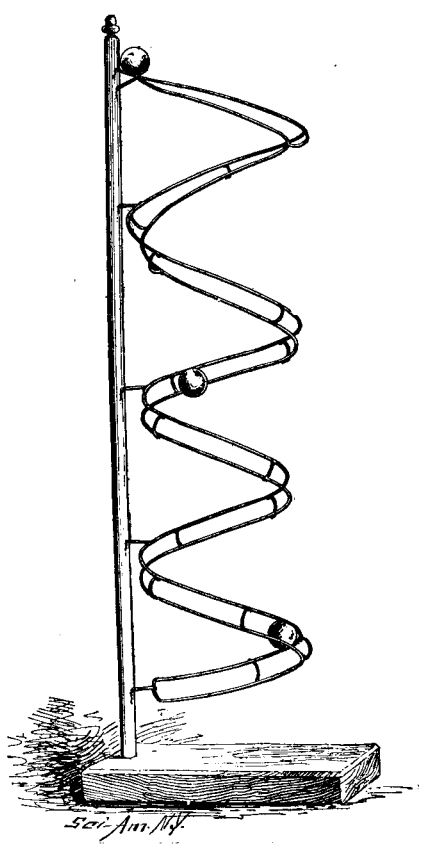


Fig. 4.—SPIRAL RAILWAY.

Detection of Gas Leakage.

Dr. Bunte's method for detecting gas leakage by means of palladium paper has been rendered still more delicate by Herr Schaufflers, who uses, to every three parts of chloride of palladium, one part of chloride of gold. The increase of sensitiveness may be partly due to catalytic action, that is, to the mere presence of the gold, perhaps to the action of traces of acetylene upon the gold solution. The solution used for making the paper contains ⅜ per cent of chloride of palladium and ⅛ per cent of chloride of gold. One pint costs about 9s., and will steep filter paper enough for 8,000 to 11,000 tests. The main sources of error are tobacco smoke, stoves, and smoky chimneys, which let carbonic oxide into the room, the vapor of fusel oil, onion smell, mercury vapor, and sulphureted hydrogen.

ACCORDING to Prof. Sargent, the strongest wood in the United States is that of the nutmeg hickory of the Arkansas region, and the weakest is the West Indian birch. The most elastic is the tamarack, the white or shellbark hickory standing far below it. The least elastic, and the lowest in specific gravity, is the wood of the *Ficus aurea*. The highest specific gravity, upon which in general depends value as fuel, is attained by the bluewood of Texas.

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ENGINEERING INVENTIONS.

A snow plow has been patented by Mr. Thomas Y. Woolford, of Augusta, West Va. This invention covers an improvement in that class of plows having a revolving wheel in front, with peripheral cutters or scrapers that dig into the snow and remove it to either side, being mounted on a truck or car and propelled by a locomotive.

MISCELLANEOUS INVENTIONS.

A washing machine has been patented by Mr. Albert M. Wilson, of Greenleaf, Kansas. This invention covers a novel construction and combination of parts in a machine designed to work easily and quickly cleanse the clothes, while being simple, inexpensive, and durable.

A dish washer has been patented by Mr. William D. Miller, of Florence, Mass. It consists of a bundle of connected links or rings of wire attached to a suitable rigid handle, whereby the washer may be conveniently and effectively used without putting the hands in water.

A nut lock has been patented by Dr. Aaron C. Vaughan, of Shane's Crossing, Ohio. It consists of a relatively thin spring nut having both the body of the nut and its thread curved, by bending the nut after threading, to clamp the bolt by its own elasticity just outside of the regular nut.

A folding fire blower has been patented by Mr. James M. McMeen, of Danville, Ill. It is made of two series of plates pivoted to a central strip, and connected at their outer ends to side strips carrying fasteners for engaging the jambs of the fireplace, the device being readily folded to occupy but little space.

A hat stretcher has been patented by Mr. Gustav E. Schellman, of New York City. Combined with an oval shaped divided main band, and a screw for adjusting its sections in or out, are independently adjustable outer curved wings to conform to the exterior of the sections, to make a hat conform to special or peculiar shapes of the head.

A leader for scarf neck bands has been patented by Mr. Michael D. Levy, of New York City. It is for attachment to the free end of the band of the scarf, for drawing the extremity of the band through the scarf, and consists of a long narrow body, flattened at one end and with hooks at the other end, with keepers for the points of the hooks.

A trousers stretcher has been patented by Mr. George H. Coursen, of Baltimore, Md. Combined with a rectangular frame and a cross bar fitted to slide on its side pieces, are a stationary and a sliding clamp, with other novel features, designed to make a stretcher that is easily manipulated, inexpensive, and that will be all in one piece.

A tricycle has been patented by Mr. Patrick Gallagher, of New York City. It has a front guide wheel and rear driving wheels mounted on a light and strong iron framework, with a suitable seat, the machine being propelled by a crank handle mounted in arms pivoted to uprights on the frame and secured in position by adjusting bolts.

A guide for sewing machines has been patented by Mary E. Hunter, of Osborn, Ohio. This invention covers a novel construction of gauge plate, especially adapted for use in sewing straw braid, and which may be applied to any sewing machine, whereby the braid may be held easily to place, so it can be rapidly and accurately stitched.

A washing machine has been patented by Alois Mueller, of Neillsville, Wis. It is a wash boiler and washing machine combined in one, the invention covering various novel features of construction and combinations of parts designed to make a machine very easy upon the clothes treated, while strong, simple, and convenient.

The manufacture of fibers of wood for spinning purposes forms the subject of a patent issued to Mr. Alexander Mitscherlich, of Freiberg, Baden, Germany. The wood is first boiled in a chemical solution, as sulphurous acid or bisulphite, the fibers then dried and softened in water, and afterward subjected to repeated mechanical pinchings.

A detachable fire pan for stoves has been patented by Gertrude N. Howe, of New York City. It is adapted to be set in the top openings of stoves, ranges, etc., for building a fire only beneath the vessel to be heated, and thus avoiding the necessity of heating the whole stove, being of very simple and economical construction, and designed to be very convenient in use.

A foot rest for stools has been patented by Mr. Gustave La Barbe, of Roseland, Ill. It consists of a pair of clamps, an adjustable ear for varying the inclination of the foot rest support, and an arm hinged to the adjustable ear adapted to receive the board forming the support for the feet, which may be attached in any desired position, let down when not in use, or folded up out of the way.

A life buoy has been patented by Mr. Philip Hichborn, of the U. S. Navy, Washington, D. C. It is a float with torch attached, having a chamber for combustibles, and a breakable or detachable seal which normally closes the mouth of the chamber water tight, being held suspended at the side or stern of a vessel, to be instantly released and allowed to fall into the water when required for use.

A pump has been patented by Mr. Hiram J. Wells, of Nashville, Tenn. The cylinder has an air-valved outlet at its lower end, the cover having a valved tube or cylinder at its upper end, and the plunger having a tubular rod with a series of air inlets at its upper end and a valve at its lower end, the design being to purify and remove extraneous substances from the water as it is being pumped.

A door or other mat has been patented by Mr. Alanson Cary, of New York City. It consists of a series of connected corrugated parallel flexible strips set edgewise, with their convex portions facing the concave portions of the adjacent strips, making a mat designed to be largely self-cleaning, and presenting a scraper-like rubbing surface for removing mud and dirt from boots or shoes.

A gate has been patented by Mr. Urbian L. Shaw, of Westfield, Ind. It consists of a series of vertical strips or slats to which diagonal and parallel bars are pivoted in such manner that the gate may be opened by folding the parts up at one side, the construction being simple, while the gate will not be easily clogged by snow or ice, and cannot be readily raised by animals.

A wall heating system has been patented by Mr. John D. Parker, of Fort Riley, Kansas. A series of flues is formed in the walls, communicating with a furnace in the lower part of the building, so that the heat of the furnace may be communicated to the walls and thence through the building, there being grates in the apartments to regulate the temperature by supplying the remainder of the heat necessary.

A mustard package has been patented by Mr. William P. Crary, of Brooklyn, N. Y. It is preferably made of glass, with a lid fitted upon it, combined with a sheet of lead and a sheet of paper placed between the lead and the contents of the package, the package being sealed at the edge of the lid by a strip of paper or other material secured by an adhesive substance both to the lid and the body of the package.

An apparatus for stopping and starting vehicles has been patented by Messrs. John J. Hooker, of Tideswell, Stockport, Derby County, and Herman Lescher and Robert G. Schwarz, of London, England. It consists of a spring barrel sliding on one of the wheel axles, with friction clutch and other gear, whereby power may be stored on descending hills and in stopping, and given out to the axle for propelling the car in starting.

A wire fence building apparatus has been patented by Messrs. John A. Hooton and Gilbert L. Wiard, of Clifton, Neb. This invention is designed to provide an inexpensive spool rack and connected tension devices by which the wires may be held and fed in pairs to the twisting device, and maintained at uniform tension to assure proper weaving in of the pickets, accomplishing the work with economy of time and labor.

An apparatus for casting traps has been patented by Mr. William M. Smeaton, of Camden Town, Middlesex County, England. It has a sectional core consisting of two movable sections at approximately right angles to each other, two hinged sections carried by one of the movable sections, while there are loose sections on the latter, with other novel features, for casting a complete trap for water closets, etc., in one piece, without seam or joint.

A well digging apparatus has been patented by Mr. William Lowman, of Marionville, Pa. This invention covers an improvement on a former patented invention of the same inventor, in apparatus for digging wells for water, oil, or gas, which may be quickly set up and taken down, is easily folded and carried by a single wagon, and in which the leverage is such that one man can operate the drill to sink wells with advantage and facility.

A process for reducing ores has been patented by Messrs. Theodore Michaut, Pierre Connoy, and Frank J. Wiest, of Boulder City, Col. It consists in mixing the pulverized ores with a pulverized compound of stated proportions of feldspar, carbonate of lime, silica, carbonate of potassa, etc., and then subjecting the mixed mass to heat, the process being especially designed for desulphurizing auriferous pyrites and other sulphurous ores.

A right and left hand stop and waste faucet has been patented by Mr. William Briggs, of Brooklyn, N. Y. The faucet casing has two sets of pin-receiving apertures at right angles to each other in one end, surrounding the key bore, the key extending through such bore and having transverse projections on its projecting end, with other novel features, providing a means whereby one device may be made to serve as a right or left hand faucet.

A machine for puncturing sheet metal has been patented by Messrs. George F. Waelde and Herman G. Cery, of Brooklyn, N. Y. Combined with a table and reciprocating frame having a series of longitudinal slotted tool-carrying bars, are clamps sliding on the bars, and other novel features, making a simple and durable apparatus, especially adapted for puncturing the members of mouldings in sheets of iron or other metals.

A horse power has been patented by Mr. Allen Sampson, of Victoria, Texas. The machine has a tilting carriage, a lever fulcrumed on its frame being connected to the machinery to be driven, while weight boxes are held to the lever and travel on the carriage during its tilting movement, with mechanism for rocking the lever and thereby tilting the carriage, making a machine by or from which a cotton gin, grist mill, sawmill, etc., may be run.

A lamp wick has been patented by Mr. Adolfo S. Yanez, of Havana, Cuba. The wick tube has a supplemental open-ended mouth piece, to form longitudinally extending spaces between the tube and mouth piece, with spacing projections, and a granular filling is used on the top of the wick in the spaces, with other novel features, designed to produce a flame which will not easily become ragged or irregular from protracted burning, while the wick can be easily cared for.

A paper box has been patented by Messrs. John F. Diemer, of Elizabeth, N. J., and Paul E. Gonon, of New York City. It has a metallic bottom plate with side bends, metallic strips on its sides, a locking plate, and other novel features, making a box for filing folded papers, documents, etc., of which the parts can be conveniently shipped in folded condition, the invention being an improvement on a former patented invention of the same inventor.

A doubling winding machine has been patented by Mr. Alphonse Ryo, of Roubaix, Nord, France. Its construction is such that, by the oscillation of a vertically swinging frame or bracket, the axis of the yarn guides is raised and they are arrested at the same level by an adjustable stop bar, to throw their eyes well forward within reach of the attendant, to render easy the piecing up of the yarn, the invention also covering various novel features of constructionand the arrangement of parts.

A machine for cutting key seats has been patented by Mr. George Benson, of Durham, England. It is for cutting key seats in wheels or pulleys, and is a reciprocating cutter in a frame having a slotted bed plate with adjustable clamps, and other novel features, being adapted to hold the saw or cutter to its work and automatically relieve it in its up stroke, to accurately adjust for the depth of cut, and provide for holding wheels of different thickness and diameter.

A regenerative gas furnace has been patented by Mr. Gottfried Pietzka, of Witkowitz, Moravia, Austria-Hungary. It is designed for reverberatory furnaces used for smelting pig metal, reheating, puddling, etc., the gas generators being at one end of the furnace and the regenerators having reversing valves and being connected with the ends of the furnace, the waste gases being passed through the regenerators, after which air is passed through them in connection with the gases from the generators.

SCIENTIFIC AMERICAN

BUILDING EDITION.

SEPTEMBER NUMBER.—(No. 35.)

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3. Perspective view and floor plans of a beautiful residence at Rochelle Park, near New York. Our engraving was made from a photograph taken specially for the SCIENTIFIC AMERICAN BUILDING EDITION.
4. Perspective and floor plans of the residence of I. C. Goodridge, Esq., at Rochester, N. Y.
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The Knowles Steam Pump Works, 113 Federal St., Boston, and 93 Liberty St., New York, have just issued a new catalogue, in which are many new and improved forms of Pumping Machinery of the single and duplex, steam and power type. This catalogue will be mailed free of charge on application.

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The Holly Manufacturing Co., of Lockport, N. Y., will send their pamphlet, describing water works machinery, and containing reports of tests, on application.

Lockwood's Dictionary of Terms used in the practice of Mechanical Engineering, embracing those current in the drawing office, pattern shop, foundry, fitting, turning, smith's and boiler shop, etc., comprising over 6,000 definitions. Edited by a foreman patternmaker. 1888. Price, $3.00. For sale by Munn & Co., 361 Broadway, New York.

Duplex Steam Pumps. Volker & Felthousen Co., Buffalo, N. Y.

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Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information, and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all, either by letter or in this department, each must take his turn.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(1) G. W. C. asks: 1. When a filter is used between steam pumps and boilers, why is it generally put between the heater and the boiler instead of between pumps and heater? A. The filter is put between heater and boiler to catch the precipitated particles of lime salts set loose from solution by heat. In heaters holding a large body of water that is quiet, these particles of lime settle at the bottom or are lodged on plates or other materials placed in the

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heater for that purpose. 2. What is the chemical reaction that causes the pulp of an apple to become reddish when cut open and exposed to the air? A. All fruit and vegetables, when cut, expose the juice and pulp to the oxidizing effect of the air. In some kinds of fruit (sweet apples for instance) the saccharine matter commences to combine with the oxygen of the air at the instant of cutting. 3. What is "setting one's teeth on edge"? A. This is a nervous condition caused by the contact of bitter or sour substances with the nerve tracks of the tongue and gums.

(2) B. G. W. asks: What substance would be best to use to fill in the decayed part of a large tree to prevent rain from soaking in? A. Use any hydraulic cement and sand, equal parts, with a coat of tar on the surface.

(3) J. F. B. asks: A good receipt for polishing iron in tumbling barrels. A. Much care is required in assorting iron for tumble polish, to avoid wearing away corners and edges of small pieces by contact with heavy work. For smoothing and clearing of scale, use sharp sand in the tumbler, enough to cover the castings or pieces, and coarse or fine to suit the work. A second tumbler should be used for polishing if the work warrants it. Use in this scraps of leather or skivings, coarse sawdust, chips from a planing machine, etc., with charcoal, pulverized pumice, rouge or plumbago for various styles of polish or for different kinds of goods. It requires a few trials to find the right material for your requirement.

(4) G. G. G.—There is not enough difference in the cost of high or low pressure steam heating, where you require high pressure for power, to be worth the attention necessary for arranging and managing two steam systems in the same house. Calling 12 square feet heating surface in your boiler equal to one horse power, you will need 120 square feet radiating surface in ordinary rooms, which will heat 12,000 cubic feet of space, or in this proportion for various sized rooms.

(5) J. M.—There is no material for springs as good or durable as steel. Hard brass is the next best that is reasonably cheap. You can buy the hard rolled brass in sheets or strips through the brass trade. German silver hard-rolled makes a fair spring, but expensive. See SCIENTIFIC AMERICAN SUPPLEMENT, No. 20, "How to Make Spiral Springs."

(6) H. J. K. asks: What power would an eight foot overshot water wheel afford, supplied from a spring that runs one gallon per minute? A. $\frac{1}{500}$ of a horse power.

(7) W. E. C. asks the proper temperature for the withdrawal of engraving tools from an oil tempering bath. The tools are intended for cutting silver, gold, German silver, etc. They come hard and have to be drawn. A. Such tools should be hardened by immersion in water or oil from a cherry red heat. The drawing of the temper in an oil bath is not reliable unless you insert a thermometer that has a scale running up to 500° Fah. You will require a temperature of about 450° for gravers. A far better way is to brighten the end of the graver on a water stone and heat in a spirit lamp until it turns a light brown color. Even this is not always an indication of hardness or toughness, as there is a great difference in the hardening process, due to quality of the steel, its hardening heat, and the kind of cooling bath.

(8) G. J. D. asks the best formula or process for coppering iron. A. Try 3 oz. sulphate copper and 1 oz. sulphuric acid to 1½ gallons clear water. The articles must be made perfectly clean by pickling in muriatic acid 1 part, water 3 parts, scrubbing bright or tumbling in sand. Dip in the copper bath for few seconds only, moving the articles about, and rinse in hot water with a little sal soda and dry quickly in sawdust. The cleaner the articles are made, the brighter the copper coating will be. Too long immersion makes the copper dull.

(9) C. C. J.—Native hematites, limonite, and magnetite iron ores are used in Pennsylvania in the manufacture of iron and steel. Other ores, the magnetites of New Jersey and Northern New York, the specular ore of Wisconsin, and the Spanish hematites are also largely used as mixtures for special grades of iron and steel. We cannot say from your description what the value of your ore would be. An analysis from fair average samples would indicate its use and value, but partially. We advise you to make fair sample lots, and submit to the steel works of Eastern Pennsylvania for trial.

(10) S. R. T. asks the approximate heating value, and the relative bulk, of a ton each of good soft bituminous coal, anthracite coal, and coke, for use in cook stoves, hot air furnaces, and grates. A. Both anthracite and bituminous coal vary in heating value, owing to varying amount of ash, so that a special comparison can only be made with coals of similar amounts of combustible to the pound. The best coals of either kind are nearly alike for given weights. The bituminous coals from different mines vary so much, and the method of firing is so variable, that the results of experimental tests do not agree, as for instance trials on the Baltimore & Ohio Railroad determined the evaporative effect of one ton Cumberland as equal to 1·25 tons anthracite. Other experiments make bituminous coal 13 per cent more effective than coke for equal weights. The average of a long series of experiments on U. S. naval vessels makes anthracite 41 per cent more effective than bituminous. For domestic purposes, as cooking and heating, the cleanliness, durability, and convenience of an anthracite fire set it far ahead of any other coals or coke.

(11) J. T.—The steam engine receives steam at 212° up to 400°, and discharges it from the exhaust or through the condenser at 100° to 180° F. This difference is the loss of heat you speak of. A pound of steam at 100 lb. pressure will expand to about seven times its volume in doing work. Its volume is 691 cubic inches. A pound of water always gives a pound of steam.

(12) T. D. McC. asks: 1. Why is it that a main line telegraph current, strong enough to give a very severe shock when broken, or to make a spark visible in broad daylight, will only just move the lever of a 20 ohm sounder which can be worked satisfactorily on one cell gravity battery? A. The shock is due to extra current developed on breaking a circuit which contains coils of wire. It is much more intense than the original current on the line. 2. What cement is unaffected by solution of blue vitriol? A. The majority of cements, such as sealing wax, are unaffected.

(13) J. L. P. asks: Would the slack from a coal mine be good as a fertilizer? A. It might be of use on a clay soil, but would act mechanically, and afford little or no real nutriment to plants.

(14) A. L. R. asks: Is there any rule for estimating the expansion of coal gas for each additional five or ten degrees of temperature? A. For each degree Fahrenheit rise in temperature, the gas expands $\frac{1}{491}$ part of its volume at 32°; as an approximation allow $\frac{1}{4}$ of one per cent for a degree.

(15) J. C. M. asks: 1. Is there any metal known to science that has more affinity for gold and silver than quicksilver? A. At ordinary temperatures, mercury is the only available metal for gold extraction. 2. Is there any way of increasing its affinity for the precious metals, more than it is when bought out of the stores? If so, what are they, and how are they prepared? A. A little sodium is often added to cause it to amalgamate better with "rusty" gold.

(16) H. D. Q. writes: 1. Am just completing the 8 light dynamo described in your paper and would be obliged to you if you will kindly give me advice on the following questions: 1. Are lamps to be a low or high resistance, and of what resistance? A. The resistance of the lamps is 50 ohms. 2. What size wire should be used to conduct the current from dynamo to lights 500 feet distant and return? A. No. 10 copper wire. 3. The manner in which the machine is wound and connected is called what? Series, parallel, or what? A. Series. 4. How are lamps to be connected? Is the inclosed sketch correct? A. In parallel, not in series, as you have shown them.

(17) J. M. E. asks how to construct a wigwam. A. The height and size should correspond with your want of accommodation. A rustic framework, using small trees and hoop poles for framing would be appropriate for a large or small wigwam. The rough side of the bark should be outside, all over. To make a knockdown wigwam, the framing should be lashed together with ropes or twine, and the bark tied to the rafters with twine. This can be done by boring holes through the bark and lapping the courses to cover the tying.

(18) R. H. S. asks a method of etching on steel that will leave the etching a gold bronze. A. The gilt inscriptions on cutlery are put on after the biting in, and before the etching wax is removed, by battery attachment in a gold solution. A superficial gilt lettering may be produced by printing the background of the design with gums that resist ether, and then dipping the article in an ether solution of gold, or dropping a small quantity of ether solution on the bright part with a camel's hair brush.

(19) E. A. G. asks if there is anything with which leather can be treated or soaked so it will not absorb or allow kerosene to pass through or penetrate it, as he desires to treat leather so as to use it as a valve against leakage from kerosene or gasoline. A. Use any soft leather that is entirely free from grease or oil. Saturate at a heat of about 150° with a mixture of 1 part by weight of good glue to 10 parts glycerine, the glue to be soaked in warm water until it swells and is soft like jelly, when the excess of water is poured off and the glycerine added, bringing the whole to a boil. Then cool it to 150°, and soak the leather thoroughly. Hang up until cold and cut the valves.

(20) C. M. D. asks if there is anything with which he can treat the inside of a new wood cistern, that will penetrate the wood and act as a preservative and at the same time not affect the water. A. Apply melted paraffine with a paint brush to the dry wood; moisture will prevent penetration.

(21) E. A. H. writes: The basement walls of my house have a coating of tar on the inside. What mixture of paint can I use that will dry thoroughly on the tar? Can I mix anything with cement that will cause it to adhere to the tar? A. A solution of shellac in alcohol may be used, and applied like paint over tar that is to be painted. Its high expense prevents the application of this on a large scale. Cement cannot be made to adhere.

(22) J. B. asks (1) whether it be possible to make a complete or partial magnetic screen. A. No. 2. Whether a soft iron sphere around the magnet, or a soft iron plate or hemisphere between the magnet and its armature, will answer? A. You merely replace the armature by the sphere. The armature will be less attracted, and the sphere will be strongly held in place.

(23) D. E. F. M. asks: What would be the chemical reaction, in burning of the solidified petroleum referred to in SCIENTIFIC AMERICAN September 1, page 131, col. 2? In what sort of apparatus could the heated mixture be safely prepared in a small way? A. The reactions would involve ordinary combustion of the hydrogen and carbon of the petroleum, and would be retarded by the solidified condition of the mixture. A glue pot would answer for experimenting with it. It should be heated with great care, best in the open air. If over a flame, a large pan of water should be kept directly under the flame. If over a range, it should be heated in a large pan of water.

TO INVENTORS.

An experience of forty years, and the preparation of more than one hundred thousand applications for patents at home and abroad, enable us to understand the laws and practice on both continents, and to possess unequaled facilities for procuring patents everywhere. A synopsis of the patent laws of the United States and all foreign countries may be had on application, and persons contemplating the securing of patents, either at home or abroad, are invited to write to this office for prices, which are low, in accordance with the times and our extensive facilities for conducting the business. Address MUNN & CO., office SCIENTIFIC AMERICAN, 361 Broadway, New York.

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September 4, 1888,

AND EACH BEARING THAT DATE.

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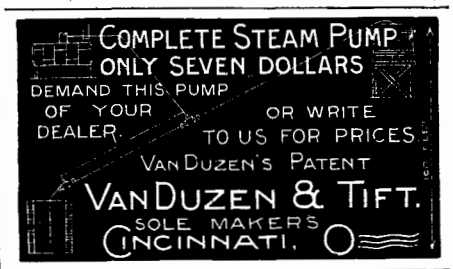

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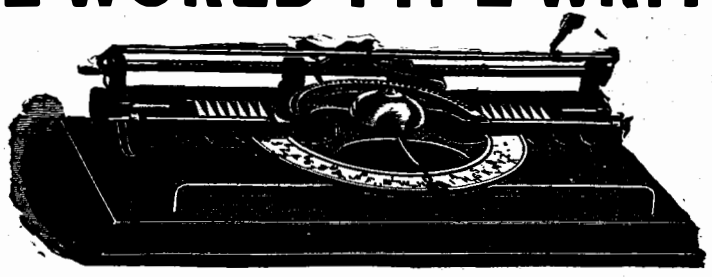

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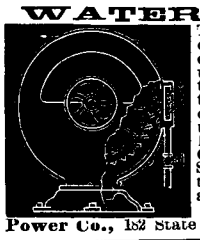

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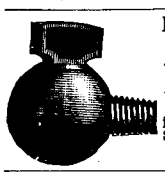

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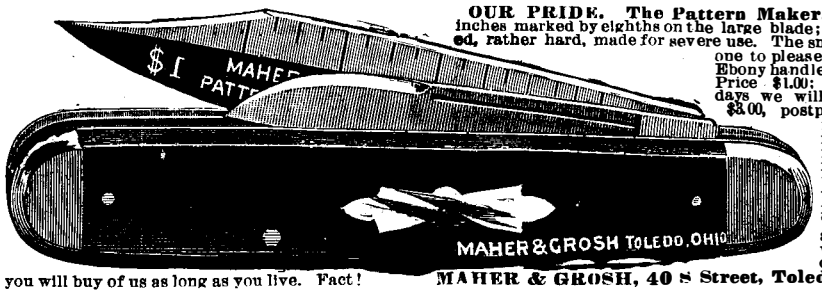

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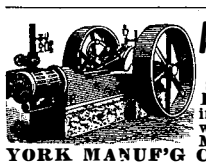

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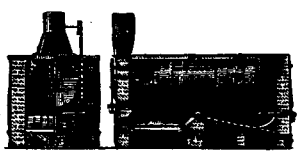

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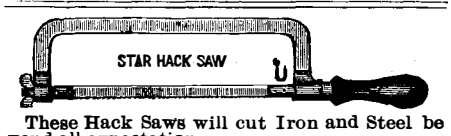

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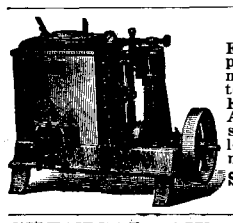

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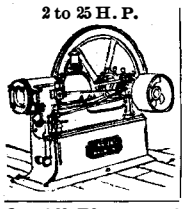

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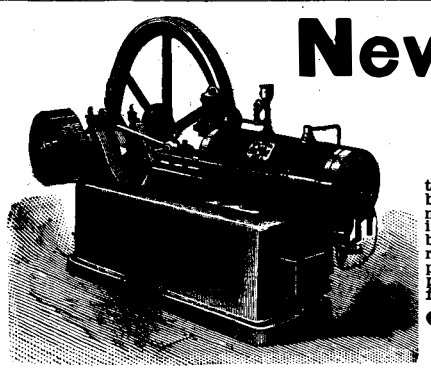

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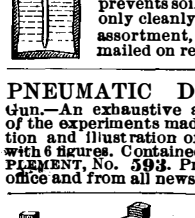

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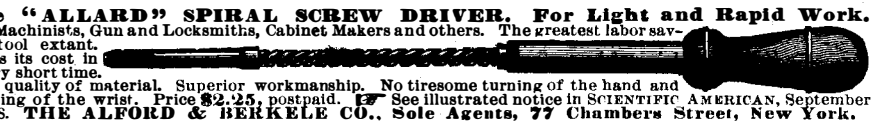

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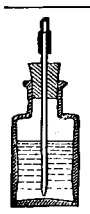

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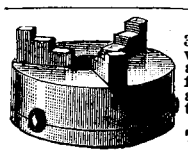

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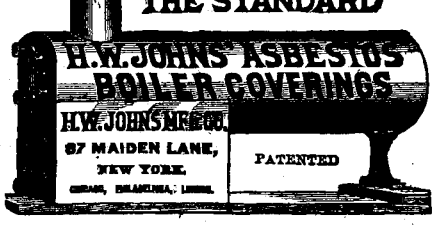

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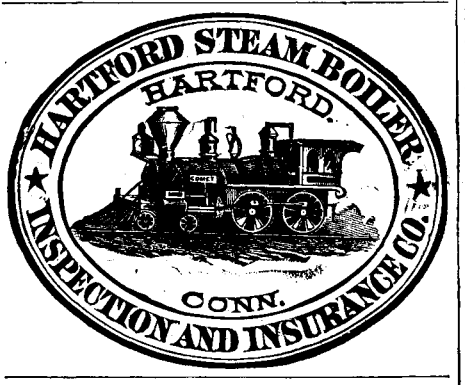

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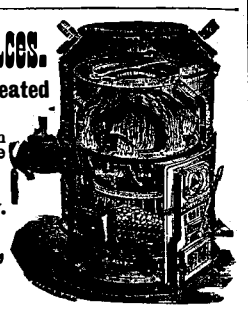

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